PARTICIPANTS AND INFORMATION OUTCOMES

IN PLANNING ORGANIZATIONS

A Dissertation

by

DAVID HENRY BIERLING

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2012

Major Subject: Urban and Regional Sciences

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ABSTRACT

Participants and Information Outcomes in Planning Organizations. (August 2012)

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This research presents empirical evidence and interpretation about the effects of planning participants and contextual factors on information selection in public organizations. The study addresses important research questions and gaps in the literature about applicability of planning theory to practice, about effects of planning participants and participant diversity on information selection, and about community and organizational factors that influence information selection in the planning process. The research informs emergency planning, practice, and guidance, as well as planning theory and practice in general.

The research sample consists of survey data from 183 local emergency planning committees (LEPCs) about their conduct of hazardous materials commodity flow studies (HMCFS), along with data from other secondary sources. HMCFS projects collect information about hazardous materials (HazMat) transport that can be used in a wide range of local emergency planning and community planning applications.

This study takes the perspective that socio-cultural frameworks, such as organizational norms and values, influence information behaviors of planning

participants. Controlling for organizational and community factors, the participation of community planners in HMCFS projects has a significant positive effect on selection of communicative information sources. Participation of HazMat responders in HMCFS projects does not have a significant negative effect on selection of communicative information sources. The diversity of HMCFS participants has a significant positive effect on information selection diversity. Other organizational and community factors, such as vicarious experience, 'know-how' and direct experience, financial resources, and knowledge/perception of hazards and risks are also important influences on information selection behavior.

Results of this study are applicable to planning entities that are likely to use planning information: proactive LEPCs, planning agencies, and planning consortiums. The results are also applicable to community planners in local planning agencies and emergency responders in local emergency response agencies, and public planning organizations in general. In addition to providing evidence about the applicability of communicative rationality in planning practice, this research suggests that institutional/contextual, bounded, instrumental, and political rationalities may also in influence conduct of planning projects. Four corresponding prescriptive recommendations are made for planning theory and practice.

ACKNOWLEDGEMENTS

NOMENCLATURE

APA	American Planning Association
BTS	Bureau of Transportation Statistics
CERT	Community Emergency Response Team
DOT	Department of Transportation
EMS	Emergency Medical Services
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-know Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highways Administration
GIS	Geographic Information System
HMCFS	Hazardous Materials Commodity Flow Study
HMEP	Hazardous Materials Emergency Preparedness
LEPC	Local Emergency Planning Committee
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RTK	Right-To-Know
SARA	Superfund Amendments and Reauthorization Act
TRANSCAER	Transportation Community Awareness and Emergency Response
TRB	Transportation Research Board
TSA	Transportation Security Administration
USDA	United States Department of Agriculture

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1. INTRODUCTION

1.1 Research Background

Informed planning and decision-making is essential for achieving sustainable and resilient communities, not just for effective management of hazards and risks (Pine, 2008), but also as a general planning principle. Yet, critical questions remain after decades of research about how to best bring about informed planning and decision-making. Across planning genres and areas of specialization, two central questions are: who should be involved in planning, and what should its fact-basis be? By addressing these questions using quantitative, multivariate analyses and data from a national sample of U.S. planning organizations, this study makes significant contributions to planning research and science.

Failure of technological systems can have catastrophic effects at local, regional, national, and even international scales, and result in hazard exposures that maim or kill individuals, dislocate entire communities and regions, and contaminate extensive areas of the environment. And, as society grows and infrastructure expands, people and the environment will continue to be exposed to increasingly complex hazards and risks, such as those associated with technological systems (Marchall & Picou, 2008). Technological hazards include hazardous materials (HazMat) releases, lethal chemical agent and munitions releases, radiological releases, airplane crashes, levee and dam failures,

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This dissertation follows the style of the *Journal of the American Planning Association*.

power failures, train derailments, and urban conflagrations (FEMA, 2010). Disastrous technological failures associated with Love Canal, Three Mile Island, Bhopal, Chernobyl, Exxon Valdez, and Space Shuttles Challenger and Columbia are a few well-known examples of what happens when technological systems fail (Clarke, 1999, 2006; Perrow, 1999). The BP Deepwater Horizon platform explosion and subsequent oil spill in the Gulf of Mexico and the Fukushima, Japan, nuclear reactor meltdown as a result of a tsunami impact are more-recent failures.

Local emergency planning committees (LEPCs) are local-level organizations that are responsible for chemical hazards planning and enabling community right-to-know about chemical hazards in the United States. A better understanding of planning and decision-making can help planning organizations—such as LEPCs—prevent, avoid, or adapt to the potential impacts of technological and other hazards (Sagan, 2004). Two important aspects of planning and decision-making are examined in this study: information selection and participation.

Good information is the basis of good planning (APA, 2010; FEMA, 2010). It is prerequisite for generating knowledge and translating that knowledge into alternatives, policy, and action (Lindell & Perry, 1992, 2004; Nijkamp, 1989). According to Innes (1998), "it is essential that the academy learn how information functions in the practice of planning…to define practices that are ethical and effective…[and] to understand and explain how and why plans are made" (p. 60). However, despite the central role of information in the practice of planning organizations and the means by which they

address public problems, few empirical studies address how information is actually selected in planning processes or by planning organizations.

Another important aspect of the planning process is the approach to planning. Increasingly, planning experts recommend communicative and participatory approaches as means of effective public planning and decision-making (e.g., Baker & Refsgaard, 2007; Dietz & Stern, 2008; Pearce, 2003; Smith Korfmacher, 2001). The emphasis on communicative rationality is an outcome of perceived failures of technical rationality (Marchall & Picou, 2008), including failures that are evidenced in technically rational planning and decision-making for disasters (G. B. Adams & Balfour, 2011; Marchall & Picou, 2008). Communicative rationality includes communicative and participatory approaches to decision-making:

- Communicative approaches to decision-making focus on two-way interactions between actors, using discussion and debate as opportunities to obtain value-laden and subjective information, and confront claims to truth and validity about the meaning of information and generated knowledge (Braaten, 1991; Giddens, 1995; Innes, 1998). The fact-basis of communicative rationality is information about the experiences, perspectives, stories, opinions, and "gut feelings" of "non-experts" who are nonetheless impacted by planning and policy outcomes of public decision-making (Innes, 1998).

- Participatory approaches to decision-making focus on involvement of different actors and stakeholders in planning and decision-making, providing an

opportunity to obtain varying knowledge, experiences, perspectives, and needs in a democratic manner (Baker & Refsgaard, 2007).

Through communicative and participatory approaches to planning, diverse community members can provide information, generate knowledge, and offer input about the hazards they are or may be exposed to and how associated risks should be addressed, thereby improving the fact-basis and equitability of planning and decision-making processes.

Both academic and practitioner literature has advocated communicative and participatory approaches to planning and decision-making, as have guidance and recommendations for disaster planning, response, and recovery by U.S. state agencies (FDCA & FDEM, 2010), U.S. federal agencies (FEMA, 2010), and international agencies (APFM, WMO, GWP, & ADPC, 2006; Jha, Duyne, Phelps, Pittet, & Sena, 2010; UNSISDR, 2010). For example, the current primary guidance for local emergency planning from the Federal Emergency Management Agency, *Developing and Maintaining Emergency Operations Plans: Comprehensive Preparedness Guide (CPG) 101 Version 2.0* (FEMA, 2010) describes that the whole community should be engaged in local emergency planning, and suggests a wide range of participants who should be involved as key planning team members or potential sources of planning information.

While a majority of studies on communicative and participatory planning suggest positive outcomes of these approaches, other studies suggest mixed or negative outcomes. Still other studies point to challenges of participatory planning generally (Beierle, 2002; Munnichs, 2004; Roberts, 2004; Smith Korfmacher, 2001), and lack of

public interest or willingness to engage in disaster planning specifically (Beierle, 2003; Simmons, 2003). A related issue concerns questions about who should have key roles in planning and decision-making. For example, in many communities emergency responders and emergency managers, who tend to come from para-military backgrounds, bear the primary responsibility for emergency planning (Pearce, 2003). There is little argument about the importance of these actors in providing effective and efficient emergency response and eliminating immediate threats to health and safety. However, the institutional contexts and professional temperaments that shape the norms, values, and behaviors of emergency responders and affiliated professions suggest they will have challenges for engaging others in communicative dialogues and participatory processes.

Successive versions of primary federal emergency planning guidance over the past two decades have increasingly reduced the role of community planners in the emergency planning process (FEMA, 1996; FEMA, 2009; FEMA, 2010). Current federal emergency planning guidance fails to specifically identify community planners as key emergency planning team members, rather indicating that they are sources of information about the community. However, community planners often value participatory planning (Johnson, 2006) and have broad knowledge of their communities, unique training and experience in communicative and participatory planning practices, and expertise in collection and evaluation of information (J. C. Schwab & Topping, 2010). These characteristics suggest that community planners can have an important role in emergency planning, and that federal guidance and local practice may be missing

an opportunity to enhance planning outcomes by excluding community planners as key emergency planning team members.

Empirical evidence about the effectiveness of communicative and participatory planning is limited, as noted by various authors (Blau, 2007; Brody, 2003b; Burby, 2003; Dietz & Stern, 2008; Johnson, Pierce, & Lovrich Jr., 2011; Reed, 2008; van Asselt Marjolein & Rijkens-Klomp, 2002; Wassen, Runhaar, Barendregt, & Okruszko, 2011). Most assessments have utilized case studies in specific locales, while a few studies have synthesized different case studies, or used smaller samples in specific states or regions. There remains a significant need for research that addresses gaps in understanding how, when, and where communicative and participatory approaches are best applied in planning and decision-making, and who should be involved. Questions remain about the utility and effects of communicative and participatory approaches to planning, and their applicability to all aspects of the planning process such as information selection. Quantitative research can help address some of these gaps and questions about how to make planning processes more effective.

The research conducted for this study uses quantitative, multivariate statistical methods to examine the effects of planning participants on information selection in planning organizations. It uses constructs of planning theory, and incorporates concepts of planning practice, organization studies, information science, public policy and administration, and sociology. The results of this research are considered with respect to their application to information selection and participation in LEPCs, and in planning organizations more generally. LEPC conduct of hazardous materials commodity flow

study (HMCFS) projects—which provide information about the types and quantities of hazardous materials that are transported in a jurisdiction—is the setting of this research. The study uses multiple linear and binomial logistic regression models to evaluate 183 responses to a national survey of LEPCs about their conduct of HMCFS projects.

Few previous studies in the planning literature assess communicative and participatory planning practice using quantitative, multivariate analyses and data from a consistent planning organizational context across the U.S. While numerous evaluations of communicative and participatory planning have been conducted in environmental planning, natural resources management, and public administration settings, there does not appear to be previous empirical analysis of communicative and participatory planning practices in an emergency planning setting. Further, research on planning often focuses on outcomes such as participant satisfaction, plan creation, or plan implementation, rather than on specific aspects of the planning process, particularly information selection as the fact-basis of planning. Through its focus on planning participation and information selection and use of multivariate quantitative analysis to evaluate behavior of similar planning organizations and settings from across the U.S., this research makes a significant contribution to planning research that is applicable and relevant to both theory and practice.

1.2 Research Objectives and Questions

The objective of this research is to inform planning theory, practice, policy, and guidance. Prominent planning theorists in recent decades (e.g., Forester, 1993; Healey, 1992; Hoch, 2007; Innes, 1996) advocate communicative and participatory-based

planning and criticizes planning approaches that are exclusively based on technical rationality. Yet, empirical evidence about implementation of communicative and participatory approaches using quantitative, multivariate assessments has been extremely limited. Planning theory needs to know how communicative and participatory approaches are evidenced in practice, and the settings in which their different theoretical constructs are applicable.

As populations expand they are exposed to increasing natural, technological, and anthropogenic hazards, leading to an increase in the number and diversity of potential emergency planning stakeholders. Planning practice needs to know which approaches are effective in various situations and who should be involved.

Federal guidance and legislation fail to recommend community planning professionals as important local emergency planning participants. Planning policy needs to know whether guidance and regulation regarding emergency planning participants are sufficiently defined and inclusive.

Under current federal guidelines, local emergency planners are expected to conduct an extremely synoptic planning process with increasingly limited resources. Planning guidance needs to know the extent to which planners benefit from resource-intensive activities such as participatory planning.

To address this objective, this research examines how HMCFS participants influence the selection of planning information by LEPCs. The research uses secondary data from a national survey of LEPCs about their HMCFS practices. The survey was conducted by Texas A&M University and Texas Transportation Institute in 2008. A

subset of 183 cases from the survey responses is examined using multiple linear regression and binomial logistic regression modeling techniques. The research specifically investigates relationships between the types and diversity of HMCFS participants and the types and diversity of information that were selected.

The underlying premise of this research is that planning participants influence the implementation of planning practices, such as selection of information. Both planning participants and the planning process are influenced by the socio-cultural contexts of planning organizations and communities. There are three primary research questions:

1. Does participation of community planners in planning projects have a positive effect on selection of communicative information?

2. Does participation of emergency responders in planning projects have a negative effect on selection of communicative information?

3. Does increasing participant diversity have a positive effect on selection of diverse information sources in planning projects?

1.3 Dissertation Structure

This dissertation is organized as follows.

Section 2 reviews the literature on planning processes and planning theory. First, it provides a brief overview of the planning process, and describes the role of information in the planning process. Next, it discusses two predominant theories— technical rationality and communicative rationality. The literature review covers benefits and limits of public planning participation and describes several reasons why public participation in emergency planning is impeded. Discussion examines the socio-

cultural contexts and roles of different stakeholders in emergency planning, focusing on HazMat responders and community planners. The section identifies studies on LEPC effectiveness and other assessments of chemical hazards planning, focusing in particular on relationships between community and organizational factors and planning outcomes, and models of planning effectiveness.

Section 3 introduces the conceptual framework for the assessment of HMCFS information selection. It presents the broad categories of independent measures that are included based on the literature review. These include the key dependent variable of information selection, the key independent variable of planning participants, as well as contextual variables of community and organization. Section 3 concludes with an explication of three research hypotheses, which are based on the study's key research questions and the literature review.

Section 4 describes the study approach and data sources, which include secondary data from the 2008 survey of LEPCs about HMCFS practices, *Census 2000* and *American Community Survey* data from the U.S. Census Bureau, the U.S. Department of Agriculture Economic Research Service's *2004 County Typology*, and other data sources. The section reviews survey and sampling approaches for the 2008 LEPC survey. It describes specific variables for each of the measure categories, including explication about variables of HMCFS information source types (dependent variables) and HMCFS participant types (independent variables). The section summarizes the types of variables identified for dependent, independent, and contextual (community and organizational) variables. An empirical model of variable relationships

is presented, and the analysis approach for multiple linear regression and binomial logistic regression is described. Section 4 concludes with an assessment of potential validity threats.

Section 5 presents the research results, including specific findings from regression models. Explication of significant predictors of information selection focuses on HMCFS participants and covers factors at community and organization levels.

Section 6 discusses implications of the study results for the fields of planning practice and theory. The discussions examine whether each of the proposed hypotheses concerning planning participation and information selection are supported by the research results. Effects of contextual variables are described as well. The discussion then synthesizes the research outcomes for important aspects of information selection, planning participants, planning organizations, and communities. Recommendations are described for LEPCs and emergency planning specifically, and also for planning theory and practice more generally.

Finally, Section 7 summarizes the research and describes its limitations and potential future research opportunities.

2. LITERATURE REVIEW

2.1 Introduction to the Literature Review

Several domains of inquiry and associated literature provide a useful context for understanding the effects of planning participants on planning outcomes. This literature review draws from planning theory, planning practice, organization studies, information science, public policy and administration, and sociology. First, this section reviews literature on the planning process and the role of information in the planning process. Next, two predominant planning theories are reviewed: technical rationality and communicative rationality. Although it is not the focus of this dissertation, technical rationality's assumptions, fact-basis, and criticisms provide a background for discussion of communicative rationality, which includes communicative and participatory approaches to planning. The benefits of participatory planning are described, as well as its limitations, particularly in the context of emergency planning.

Building on the concept of participatory planning, the discussion describes the important role of participant choice in the planning process, focusing in particular on the socio-cultural contexts of two types of emergency planning stakeholders—emergency responders and community planners—and the resulting implications for emergency planning. Next, the section covers contextual elements of organizational and community influences on planning processes, drawing especially from information science and emergency planning literature. The final section summarizes gaps in the literature and research needs.

2.2 The Planning Process

Community planning is an activity in which organizations, groups, or individuals attempt to promote the common welfare while reducing uncertainty about future conditions that may affect a community. It is a "process for determining future action through a sequence of choices" (Davidoff & Reiner, 1962, p. 103). Friedmann (1987) identifies the planning process as one of applying reason to solve a problem by defining it, analyzing the situation, designing potential solutions, and evaluating the alternatives. Building on Friedmann's definition produces the following description for a planning process by which planners:

A. Review conditions, identify potential problems, and collect the information necessary to evaluate the problem;

B. Interpret and analyze the information to produce knowledge;

C. Apply knowledge by developing and designing potential solutions;

D. Evaluate alternative solutions and present plans to decision-makers, who select a course of action (outcomes);

E. Review planning outcomes to generate new information; and

F. Continue the cycle iteratively beginning with Step A.

The planning process, illustrated in Figure 1, can break down at any point, evidenced by efforts spent gathering the wrong information, use of inappropriate methods to evaluate information, failure to develop knowledge by planning participants and stakeholders, suppression of knowledge through political influence, development of plans that "sit on the shelf" (Burby, 2003), and failure to identify whether policy is

having intended effects (Flyvbjerg, Bruzelius, & Rothengatter, 2003). Different model

approaches, or theories, about how planning should be conducted have been advanced

by proponents and criticized by detractors. Section 2.2 presents an overview of planning

theories.
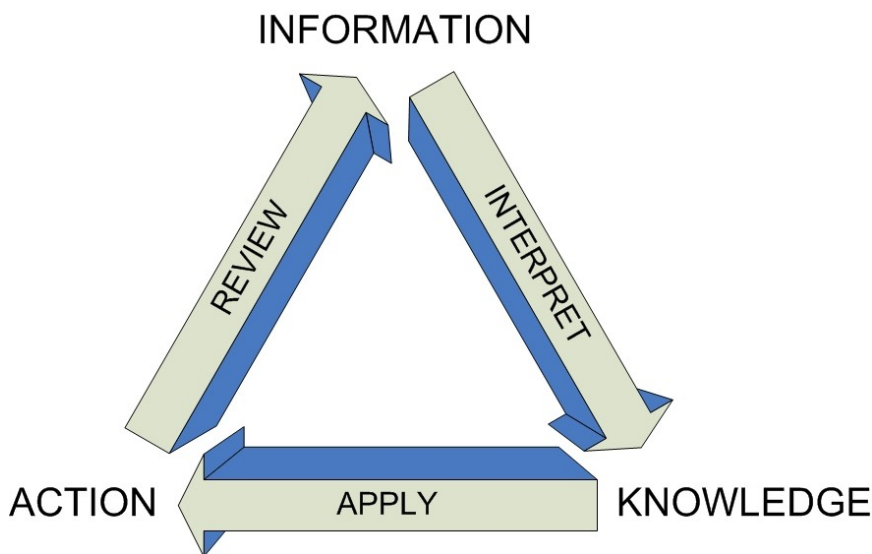
Figure 1. The planning process.

2.3 Planning Information

As described above, information is a foundational element of planning and

decision-making processes. Information is a collection of data (Nijkamp, 1989) that

gains meaning through context—its relevance to its domain, its description of problem

characteristics, and its problem-solving nature (Byström & Järvelin, 1995). Information

is static and simply descriptive, an "abstract tool" (Byström, 2002). In an information-

seeking context, information is collected via different channels and from different

sources to produce a positive change through knowledge generation (Byström &

Järvelin, 1995).

Planning organizations and federal agencies agree that good information is the

basis of good planning (APA, 2010; FEMA, 2010). Information is a strategically

essential organizational input (J. S. Adams, 1980) and is prerequisite for generating

knowledge and translating that knowledge into alternatives, policy, and action (Lindell

& Perry, 1992, 2004; Nijkamp, 1989). Planners use information to reduce uncertainty

and equivocality (Daft & Lengel, 1986). Through communicative discussions and

agreements about information and responses to new information, it can alter judgments

of decision-makers (Hanna, 2000). Information can even sway decision-makers away

from predisposed judgments (Wood & Vedlitz, 2007). This makes information a critical

planning resource (Lindell, Prater, & Perry, 2006) and a force for innovation and change

(Meyer, 2005) to help focus attention on problems and define policy agendas in federal

and state government (Kingdon, 1995) as well as local government settings (Liu,

Lindquist, Vedlitz, & Vincent, 2010). It interacts with conditions, perceptions, and

institutions in defining issues that receive public attention (Wood & Vedlitz, 2007).

When it acts through markets and public opinion, information can function as a

regulatory mechanism, a concept that is especially key to disclosure of environmental

contamination and social risks by industry (Kleindorfer & Orts, 1998).

This research takes the position that better knowledge and alternatives can

potentially be generated with more high-quality information rather than with less.

However, this does not mean that planners will adequately pursue information. For

example, Brody (2003a) studies 30 local ecosystem management plans in Florida and reports that the collective information fact-basis of the plans is the weakest of five components that describe plan quality, even with strong interest in this component by state and federal agencies. The potential value of information does not guarantee its appropriate use, and too much information can overwhelm users. Mooers' Law states that "an information retrieval system will tend *not* to be used whenever it is more painful and troublesome for a customer to have information than for him not to have it" (Mooers, 1996, p. 22). In order to avoid the "painful and troublesome" responsibilities that come with collecting, evaluating, and using information, along with the possibility that the information discovered will be inconvenient, some planners avoid certain information sources altogether.

Feldman and March (1981) demonstrate how organizations can misuse information even when it is available, and they suggest that organizational demands for more information are due to its utility as symbol and signal that the organization is behaving in a rational way, rather than its utility for and use in and actual decision-making. It appears that on one hand organizations have significant challenges for correctly gauging the amount of information they actually need for decision-making, and on the other hand they have challenges knowing how to appropriately use information once they have collected it.

Information can be costly to obtain, challenging to process, and difficult to analyze and use (Forest & Mehier, 2001; Mooers, 1996). Furthermore, not all information has the same quality, timeliness, relevance, legitimacy, or usefulness to a

given planning effort (Dietz & Stern, 2008; McNie, 2007). For information to be most useful, it must be available, accessible, timely, and relevant to its political, social, and economic context. It must be credible and dependable, which is affected by several factors such as its sources and the authority, expertise, or social standing of those who obtained it (Huotari & Chatman, 2001). It must also be legitimate and transparent, free from persuasion and bias and produced in an open and observable way (McNie, 2007).

Information can transcend time, and even multiply in value over time as it is shared, making quantification of its value difficult (Meyer, 2005). New information and discussions about the meaning of information can cause people to change their viewpoints (Ambruster, 2008; Wood & Vedlitz, 2007). "The ultimate metric for what constitutes useful information is whether the information is actually used to improve decision-making by expanding alternatives, affecting choice, and enabling decision-makers to achieve their desired outcomes…more generally, the common interest" (McNie, 2007, p. 20).

Choo suggests that "information seeking and use has always been an intrinsic and important component of the theorizing in organization science about decision making, innovation, organizational sense-making, and knowledge creation" (Choo, 2007, para. 1). According to Innes (1998), "it is essential that the academy learn how information functions in the practice of planning…to define practices that are ethical and effective…[and] to understand and explain how and why plans are made" (p. 60). However, despite the central role of information in the practice of planning organizations

and the means by which they address public problems, this literature review identified

few empirical studies on the selection of information in urban planning settings.

2.4 Planning Theory

Put simply, planning theory describes how planning should be done and who

should be doing it. As yet, there is not a universally accepted planning theory; as

planning has evolved, various descriptive and normative theories have emerged. The

struggle to define a generalized theory of planning stems from gaps between

perspectives of academics and practitioners (Kiernan, 1983). Academics seek to develop

models of planning through theories, their underlying epistemologies, and constructs.

Practitioners seek a positive basis for application of theory that is practical, useful, and

grounded in what planners do. Two planning theories are especially dominant in the

literature—technical rationality and communicative rationality.

2.4.1 Technical rationality

Planning was historically, and in many cases remains today, a technically based,

data-driven process, conducted "top-down" by planning professionals on behalf of the

public (Hemmons, Bergman, & Moroney, 1978; McGuirk, 2001). That is, technical

rationality is planning by experts *for* the people. With its roots in Max Weber's theories

of bureaucracy (Giddens, 1995) and in systems engineering, technical rationality

emphasizes technical and quantitative analyses independent of emotional debate

associated with participatory approaches (Friedmann, 1987). Technical rationality has

been a preferred approach of industrial, scientific, and government leaders (Fischer,

1991; Weber, Leschine, & Brock, 2010). It is based on a tradition of economics,

emphasizing measurement and a "balance sheet" approach by which interpretation of reality (e.g., social or environmental) is attempted. Technically rational approaches assume that an independent, value-free analyst uses information in an attempt to maximize the public good (Feldman, Khademian, Ingram, & Schneider, 2006; Innes, 1998). Technical rationality has a normative basis in its focus on objectivity: planners should use a technical approach for generating knowledge, and should view power and politics as secondary in importance to "rational" analysis.

What kinds of information are useful under a technical rationality framework? In one view, technical information is defined by its conformity with strict scientific methods based on technicality and replicability. In another view that is more amenable to scientific investigation of problems, technical information "refers to empirical information gathered by (supposedly) competent professionals concerning the magnitude of the problem(s) being addressed, the probable impacts of alternative policy decisions, and/or the impacts of past decisions" (Sabatier, 1978, p. 397). In its strict sense, technical information is values-free and does not depend on a subjective basis.

Use of value-free objectivity implemented through a logical, systematic process provides planners with a claim to professionalization of their craft (Kiernan, 1983), a clear basis for decision-making (Lawrence, 2000), reassurances they are "doing the right thing" (Baum, 1986), and a means of making plans defensible and comparable (Brody, 2003a). However, a significant challenge for technical-rational decision-making is that scientists and technical experts—those often placed in charge of these processes—have very different understandings of information and decision-making approaches than

politicians and the general public (Innes, 1998). Such differences are often blamed for wide performance disparities between intentions of decision-making—to address 'wicked problems' (Rittel & Webber, 1973)—and the outcomes of decision-making (Stern & Fineberg, 1996). Thus, some researchers have come to question the influence of science and advice of technical experts in policy settings (e.g., Fischer, 1991; Weber, et al., 2010).

Technical approaches can result in a breakdown of intentions—that is, organizations with limited resources have difficulty understanding the methodology, performing the analysis, and organizing the output in a way that is useful to decision-makers, even for simple problems. The process can be very data intensive, even if the approach is bounded. Technical data sources must be valid, reliable, accessible, and scalable. This is difficult to achieve in practice. Time and training are necessary to implement technical approaches (Rosenfeld et al., 2009), and such resources may be in short supply.

Herbert Simon and James March (March & Simon, 1958; Simon, 1978, 1983) recognize that synoptic technical rationality is practically impossible to achieve in organizational practice. They explain that rationality is inherently bounded by human, contextual, or technological limitations. Organizational operating procedures are established to achieve organizational objectives, including accomplishment of key organizational tasks. However, organizations responsible for decision-making (and their representatives) may be pulled between wanting more analysis and deliberation of results, and the need to reach decisions (Stern & Fineberg, 1996). Further, social

problems are difficult to quantify in a manner that lends itself to technical problem-solving approaches (Jones, 2002; Nijkamp, 1989). Decision-makers may "blindly" accept technical results without considering the validity or accuracy of underlying information (G. O. Rogers, Sorensen, & Morell, 1991), and bounded rationality can lead to underestimation of risks (Lindell & Perry, 2004).

Planning has different problem sets than technical fields where rational approaches show their strengths (Forester, 1993), such as engineering, mathematics, or medicine. Even those problems that can be quantified are subject to value-judgment biases and temporal changes (Braybrooke & Lindblom, 1963; McGuirk, 2001), and the idea of unbiased analysis is unrealistic in practice (Feldman, et al., 2006; Sabatier, 1978). As a "means-ends" approach, some knowledge of which ends are desired is prerequisite, but that may not be the case since desired ends may conflict (Forester, 1993) among planning stakeholders who have different value sets.

Some stakeholders may use technically based approaches to purposely deceive or confuse the public (Nijkamp, 1989) or to counteract citizen or interest group concerns. Policy makers (and decision-makers) may use technical research or formal studies to postpone dealing with problems (Etzioni, 1967). In some cases, technical solutions to problems may be preferable to solutions requiring behavioral change, especially for politicians wanting to retain the good will of their constituents because fostering change in human behavior is inherently difficult. Obscuring values-based information within technical language can change public perceptions about risks and vulnerability (Cortner, 2000; Sabatier, 1978). Related to this, and especially problematic for planning, is the

exclusion of "non-scientific" knowledge from the decision-making process (Innes, 1998; McGuirk, 2001).

Such problems and failures of technically rational planning processes led planning theorists to begin exploring other decision-making frameworks in earnest in the late 1970s. These theorists began to build especially upon Habermas' Critical Theory (Forester, 1993; Healey, 1992; Hoch, 1994; Innes, 1996) and promoted communicative-based, participatory processes to be conducted with the public and coordinated by planning professionals. However, technical rationality still retains a strong basis in both planning education and practice (Baum, 1986; Innes, 1998; Lawrence, 2000).

2.4.2 Communicative rationality

Communicative rationality is planning *by* the people. As a broad area of planning theory with sub-elements including communicative, participatory, transactive, collaborative, and consensus-based approaches, communicative rationality generally emphasizes 'discursive' and 'democratic' ideals. There is a strong reliance on public participation and deliberation, as well as inclusion and involvement of a diverse range of participants. Communicatively-rational approaches emphasize access and input to the planning process by all affected parties (Innes, 2004)—or those who represent them— and increased communication between decision-makers and affected publics (Koontz & Johnson, 2004) throughout the planning process (Moote, McClaran, & Chickering, 1997).

The Critical Theory laid out by Jürgen Habermas provides the normative basis of communicative-type approaches: planning should include all affected parties in the

decision-making process, and planners should promote mutual understanding about truth claims based on sincere, honest interaction and debate between those who have power and those who do not (Braaten, 1991; Giddens, 1995). In this way communicative planning is inherently participatory and deliberative.

While Vatn's review of the literature traces proponents of deliberation back to Aristotle and Rousseau (Vatn, 2009), Godschalk and Mills (1966) were among the first planners to specify communicative and collaborative approaches to the planning process and test the approaches in practice. Another important early work on participatory approaches in public deliberation was the development of a typology characterized as a "ladder of participation" by Arnstein (1969). This ladder ranges from outright manipulation and therapy at its lower end through full citizen control, delegated power, and partnership at its upper end of citizen participation and power. Between these extremes are what Arnstein refers to as degrees of "tokenism" to include informing, consultation, and placation at increasing levels of citizen participation in planning.

But it was not until the late 1980s into the 1990s that communicative-based planning gained serious traction. Communicative planning receives recognition for its importance in modern planning theory (Laurian & Shaw, 2009), and has enjoyed a favored status in academic literature over the past two decades. A review by Lauria and Wagner (2006) of 114 journal articles, books, and sections on planning theory identifies that 39 percent were oriented to communicative planning theory or critical theory, while only 4 percent were oriented to 'rational' planning. As communicative planning theory gain increasing attention, some advocates suggested a paradigm shift to communicative

planning (Innes, 1996) versus other approaches (Hoch, 2007), and especially versus technical-rational planning (Archibugi, 2008; Feldman, et al., 2006).

What kinds of information are useful under a communicative rationality framework? A primary mechanism through which communicative rationality operates is generation of information that would not be available through technical approaches. Communicative information includes the subjective experiences, perspectives, stories, opinions, and "gut feelings" of non-experts who are impacted by planning and policy outcomes of public decision-making (Innes, 1998). When such information is brought into the decision-making process, it can help benefit decision outcomes (Fritsch & Newig, 2007) in their relevance and equity for affected stakeholders.

Information and participation are intricately linked, and this is influenced by who is participating in planning processes, and how they are participating (Hanna, 2000). In practice, communicative information is captured through observations and self-reports by planning participants, interviews with them, and archival information such as media reports (Innes, 1990). Interviews are an important mechanism for obtaining communicative information from people that is not available through technical sources (Corburn, 2004; Hoch, 2007; Innes, 1990; Wesselink & Paavola, 2011). However, they can be expensive, they can lack clarity and allow for truth distortion, and participants must clearly understand the interview questions in order for interviewers to obtain the desired information (Innes, 1990).

The communicative planning process does allow for the inclusion of technical information in deliberative processes. However, requirements for understanding and

agreement about legitimate planning information by a broad range of planning participants (Innes, 2004) places significant constraints on inclusion of technical or expert-based information in consensus-based decision-making approaches.

2.4.2.1 Benefits of participation

Numerous planning scholars consider communicative planning, participation, and deliberation to be particularly effective for planning issues of critical importance (Innes, 2004; Weeks, 2000). Especially in environmental and resources planning, planning scholars have promoted and studied participation as a mechanism for decision-making. The National Research Council (Dietz & Stern, 2008) conducted a comprehensive analysis of participation in environmental planning. That study concludes that participation can improve the quality of outcomes, legitimize decisions, build decision-making capacity of those involved in studies, and lead to better results.

Brody et al. (2003) suggest that since the breadth of planning participation is an indicator of planning success, this makes breadth of planning participation a good proxy for an organization's ability to engage the public. Burby (2003) indicates strong plans are an outcome of broad stakeholder involvement in planning because of the information, understanding, and problem-solving such involvement produces. Burby suggests that both strong plans and stakeholder involvement are needed to affect local government actions. He notes that failure to include interested stakeholders in planning can have several negative effects, including failure to benefit from local knowledge, development of plans that result in irrelevant proposals or those that have latent local

opposition, and uncertainty among decision-makers about public preferences and the need for government action.

A number of studies show that broad community participation in planning improves the quality of planning outcomes (Burby, 2003; Koontz & Johnson, 2004; Leach, 2006; Leach & Pelkey, 2001; Selin, Schuett, & Carr, 2000; Wassen, et al., 2011). Although this concept is important for understanding planning organizations and processes, quantitative, empirical studies on communicative planning theory are limited as noted by various authors (Brody, 2003b; Burby, 2003; Dietz & Stern, 2008; Estornell, 2010; Reed, 2008; van Asselt Marjolein & Rijkens-Klomp, 2002; Wassen, et al., 2011). The large majority of studies in the 1990s and 2000s on communicative planning theory—around 90 percent—are either case studies or qualitative research designs (Lauria & Wagner, 2006). Beierle and colleagues (Beierle & Cayford, 2002; Beierle & Konisky, 2000) and Webler & Tuler (2002) synthesized participatory planning case studies and noted the challenges to empirical analysis due to gaps in data and a lack of consistent measures and variables across cases. The National Research Council concludes that "few studies have rigorously and empirically compared participation formats, incorporating multiple cases with two or more formats" and also that "it may not be the format itself that matters, but practices carried out within the format" (Dietz & Stern, 2008, p. 114).

Based on the review of participatory planning literature, it appears that evidence for importance of a broad range of stakeholder participants is mixed, although generally more positive than negative. Burby (2003) finds a positive (but statistically weak)

relationship between the number of types of stakeholders who participated in plan-making, and the number of proposed hazard mitigation measures and the success of implementing plans in 60 communities in Washington and Florida. He also reports that participation of certain types of stakeholders in planning efforts was a significant factor in planning outcomes. Among these outcomes is a significant positive relationship between participation of community planners in planning activities and the number of hazard mitigation measures that were proposed, but their participation was not significantly related to the success of implementing proposed measures. Participation of local government departments and other local government officials was a significant positive predictor for both outcomes.

Brody (2003b) evaluates the effects of having a wide range of stakeholder participants involved in planning on environmental plan quality for 30 Florida communities. He finds that the presence of a wide range of participants in planning processes was not significantly related to plan quality. Brody suggests this may be due to procedural burdens for incorporating diverse perspectives, difficulties in reaching consensus on controversial planning alternatives, and reaching consensus on planning alternatives that do not enhance plan quality. For these plans, the presence of specific types of key stakeholders (industry and non-governmental organizations, or NGOs) in the planning process is more important than the number of different stakeholders for enhancing plan quality.

Leach and Pelkey (2001) analyze 37 studies on watershed partnership efforts in the United States, Canada, and Australia to identify common themes and lessons learned.

They find that around 43 percent of the studies affirm the importance of broad or inclusive membership in watershed planning; around 22 percent contradict the importance of this factor. Leach (2006) reports similar results for 25 empirical studies of U.S. Forest Service public participation: in 40 percent of the studies, broad or inclusive participation support project success, but in 24 percent of studies, it detracts from success.

Selin et al. (2000) surveys 267 participants from 30 collaborative Forest Service projects representing public and private sectors. Out of 21 measures of planning outcome effectiveness, broad representation of stakeholders has the highest level of agreement about its importance for collaborative planning effectiveness (4.05 out of 5.00 on a scale of 1 = strongly disagree to 5 = strongly agree). This factor has a significant positive relationship with the level of outcome achievement (measured on a multi-outcome scale). Tuler reviews 11 studies for the National Research Council (Dietz & Stern, 2008), each of which examine between 7 and 118 cases, and finds that broad representation of interested and affected parties was consistently identified as contributing to project success through competence, legitimacy, and capacity.

Wassen, Runhaar, and Barendrecht (2011) analyze stakeholder participation in 13 environmental modeling efforts in a predominantly European context. Although that study does not provide significance of results, the authors indicate evidence that greater stakeholder involvement is positively correlated to model acceptance. Model acceptance is identified as having a positive relationship with implementation. They also find what they describe as weak evidence between the amount of stakeholder input and acceptance

of model outcomes, and they posit the strength of this relationship is due to the nature of input in these technical projects as predominantly scientific in origin. Wassen, Runhaar, and Barendrecht (2011) find evidence that greater stakeholder involvement was positively related to learning through debate and exchange of ideas between planners and stakeholders. Following on Arnstein (1969), such participation may even enhance the ability to shift from command-and-control (one-way) modes of decision-making in organizations toward a more inclusive mode (Hildebrand, 2009) where citizens have greater power from active participation in technical aspects of decision-making, and in keeping with the spirit of deliberative democracy (Burby, 2003).

2.4.2.2 Limits of participation

Some participatory approaches have been successful in achieving involvement of members of the general public in planning and decision-making, even for technical applications (Fischer, 1991; Innes, 1996). However, participatory planning has its limits and challenges and, when done incorrectly, has even been found to make planning efforts worse-off, not better (Dietz & Stern, 2008).

When decision-making involves multiple organizations, the time needed to reach decisions increases (G. O. Rogers, 1992), and participatory, communicative-based planning can be an extremely time-consuming process (Altshuler, 1973; Fischer, 1991) for which neither the public nor business interests have time or patience. When resources are limited, collaborative and communicative planning efforts face even greater challenges, and this is particularly evident in rural communities (Hoard et al., 2005). Political and power-based processes may corrupt the participation, and

participants often fail to act in a truthful manner (Flyvbjerg, 1998; Forester, 1993). Conflicts associated with differing viewpoints can create potential for alienation among participants (Ambruster, 2008). Mediation-based participatory approaches may fail to include less-influential stakeholders in attempts keep decision-groups small (Fischer, 1991; Vatn, 2009).

Participatory-based planning efforts frequently fail to adequately use scientific or technical information, and technical experts may shun participation due to frustration of dealing with lay persons who frequently misestimate risks (Beierle, 2002). Proponents of participatory approaches risk replacing validity with consensus as a criterion for decision-making (Faludi, 1973). Munnichs (2004) argues that in highly technical decisions about risk, it is not so much the knowledge of lay people that is of critical importance in deliberation about policy alternatives but debates among scientifically skilled experts in open, value-neutral planning processes. Blau (2011) critiques communicative rationality as being insufficient to support the requirements of deliberation and rational decision-making, and communicative theorists as unnecessarily attacking instrumental rationality. Others criticize communicative planning as focusing too much on the process of "transformative intervention" rather than on planning's core tasks of understanding and evaluation of urban development (Yiftachel, 2006). As a result of such limits and critiques, claims of paradigm-status for communicative-based planning theory have been received with caution and criticism (Archibugi, 2008; Huxley & Yiftachel, 2000; Yiftachel & Huxley, 2000).

There are substantial challenges that participatory planning faces in the context of local emergency planning committees. Federal legislation mandates communities to establish LEPCs, and although membership of these planning organizations draws from a wide range of community stakeholder groups, this membership is voluntary. Further information about LEPCs is provided in the discussion on the research setting in Section 4 and Appendix A.

The purpose of LEPCs is to plan for chemical emergencies, and enable the "right-to-know" of the community about risks due to chemical hazards. In the literal sense based on legislation that mandates LEPCs, they are collaborative and participatory in nature, providing a forum in which the topic of chemical hazards in the community may be discussed, deliberated, and addressed. However, a significant challenge for LEPCs is the volunteer nature of their membership, with other personal or professional commitments inhibiting participation. Participation of the public in planning efforts in general is often lacking (Ebdon & Franklin, 2006), a condition not limited to emergency planning. Roberts (2004) summarizes numerous reasons why direct citizen participation in deliberation is challenging, and there are three that may have particular bearing for LEPCs:

A. Decision-makers overtly or subconsciously exclude the public from participating through agenda-setting and process control;

B. The general public has low interest in emergency planning, declines to participate, and trusts public safety agencies to handle planning as a function of their responsibilities; and

C. Regulatory bodies and decision-makers create barriers to public participation given the technical or sensitive nature of the information.

Administrators can have objectives of controlling the agenda for public meetings (Kingdon, 1995), and planners do not want to lose control over the planning process through citizen involvement (Brody, et al., 2003). In the U.S. Environmental Protection Agency's (EPA's) 2008 survey of LEPC practices, only 60 percent of active LEPCs report complying with mandates for notices of public availability of emergency plans and chemical hazard information (EPA, 2009a); only half of LEPCs reported making such notices in 1999 (Starik, Adams, Berman, & Sudharsan, 2000). Irvin and Stansbury's (2004) review of the literature suggests that public consultation by security-related agencies is done primarily for public indoctrination purposes.

Wheeler (2000) notes that metropolitan residents have little incentive or encouragement to gain knowledge, think regionally, and take long-term planning perspectives. Irvin and Stansbury (2004) indicate that public complacency created problems for environmental planning in Omaha, Nebraska. Rich et al. (1993) report low levels of public information inquiries in LEPCs. Beierle (2003) reports on a lack of requests by local community members for information about chemical hazards—citing two studies in which a majority of LEPC informants indicated few or no requests for emergency planning information about chemical hazards, and two other studies where industry briefings about hazards were poorly attended. Among reasons for limited public planning participation listed by Roberts (2004) is that "unlike public officials, citizens do not have the time or interest to deliberate for the purpose of developing

informed public judgment" (p. 316). A lack of interest among citizens may cause a lack

of interest and political priority by public officials because the potential for disaster

seems low (Somers & Svara, 2009).

Trust by community leaders in government and industry to act benevolently on

their behalf may contribute to a lack of citizen participation in emergency planning.

Paton et al. (2010) report their observations of hazard planning behavior in international

countries, which

> offers some support for the idea that, irrespective of culture, the more that
>
> citizens are able to collectively formulate their risk management needs and
>
> strategies and the more they perceive their need as having been met
>
> through their relationship with civic agencies, the more likely they are to
>
> trust them and the information they provide, and to use the information to
>
> decide to adopt hazard preparation measures (p. 193).

Palenchar, Heath, and Orberton (2005) report high levels of citizen confidence in

industry to take appropriate counter-terrorism measures. The authors suggest that

support of industry in this role may be in association with knowledge of the Responsible

Care program, an industry-based effort established to meet minimum regulatory

requirements for community right-to-know, including community advisory panels.

Aside from questions of whether the general public is even interested in

participating in deliberative planning processes, the general public may be better served

through representative stakeholder approaches rather than democratically deliberative

approaches. Reasons include the highly technical nature of the planning information that

cannot be understood by most local officials or citizens (Lindell & Perry, 2001), and the impracticality of educating all participants about planning concerns (Dietz & Stern, 2008). This calls into question the degree to which full citizen participation in some emergency planning activities can be realized as envisioned by communicative and participatory planning theorists, and by federal emergency planning guidance (FEMA, 2009; Leach & Pelkey, 2001).

Burkhart (1991) suggests that media personnel are separate from both emergency planners and the public, but if they lack of technical knowledge about a topic, they can act as surrogates for the public. "In this role, they would absorb and transform technical information provided by either experts or mediators between experts and laymen, and relay that information to a public that is often even less well prepared to grasp technical information and concepts" (p. 76). If public perceptions of this role are consistent with this perspective, it may offer some explanation for a general lack of interest and participation by the public in emergency planning: they trust the media to alert them and mediate with the bureaucrats and "technocrats" on their behalf. On the other hand, media personnel generally have low levels of involvement in LEPCs (Starik, et al., 2000), and have been observed to have little influence on local government agenda-setting (Liu, et al., 2010).

A further issue is the sensitive nature of some emergency planning information. Those concerned about protection from the malicious use of such information for illicit activities (e.g., industrial espionage or terrorism) view information about hazardous materials in a community from a different perspective than those concerned about the

public's right-to-know (RTK) about hazards. Although RTK advocates identify a range

of public benefits for dissemination of risk information, those with a security-oriented

perspective identify the threats associated with malicious activities that information

potentially enables. Industry has protested attempts to develop federal programs for

disclosure of risk information, citing data management costs, increases to chances of

terrorist attaches, release of confidential business information, and public

misunderstanding (Beierle, 2003). Especially since the terrorist attacks in New York,

Washington D.C., and Pennsylvania on September 11, 2001, transparency of decision

processes and openness to collaboration have been reduced between U.S. emergency

management agencies and non-governmental organizations (Waugh, 2009).

In some cases, business interests may collaborate with security and safety

agencies or other entities to circumvent planning efforts (Flyvbjerg, 1998, 2002) or

release of planning information (Beierle, 2003). This can be especially challenging for

the role of LEPCs in enabling to a community's right-to-know, since industry has been

ranked only behind local government in terms of financial support of LEPCs (O'Leary,

1995), creating the potential for conflicts of interest. Some data are considered sensitive

security information, which limits distribution to government officials with a need-to-

know (TSA, 2004), or are given other distribution limitations such as restrictions for

release of 'Offsite Consequence Analysis' data (Beierle, 2003; Belke, 2000).

The Federal Emergency Management Agency (FEMA) indicates that engaging

communities in emergency planning is one of the biggest challenges facing emergency

planners, associated in part with security concerns for involving non-governmental

participants (FEMA, 2010). In a study by Rich et al. (1993), while three-quarters of LEPCs indicated they had a better than a 50/50 chance of accomplishing their goal of effective response to information requests, only a third indicted they had a better than 50/50 chance of securing adequate citizen input or stimulating environmental discussion. Half or less indicated they had better than a 50/50 chance of improving community understanding of risk or informing the public about emergency plans.

Technical and security concerns notwithstanding, Rich et al. (1993) suggest that the intended role of LEPCs may not be entirely participatory:

> Title III requires that each committee include police, fire, civil defense, public health, hospital, and transportation officials, as well as representatives of facilities subject to Title III reporting requirements, citizens' groups, the media, and elected local officials. The LEPCs' primary role is to prepare and update integrated local emergency response plans for their communities. But they are also to involve the public in the planning process and to make available to the public information on the presence of hazardous materials in their communities and any release of these chemicals into the environment (p. 16).

In this sense, an LEPC is intended to be representative, but not necessarily democratic or participatory except to the extent of getting the public involved through citizen group representation and making available (not distributing, per se) hazard information. Lindell and Perry (2001) point out that:

> SARA Title III explicitly provided for public access to EHS data and vulnerability assessments, but did not explicitly require LEPCs to engage in active dialogue with the community at these stages. However, the law did envision public participation once a local emergency operations plan

had been devised and implicitly presumed that a risk dialogue would mobilize community support for the implementation of the selected hazard management strategy (p. 170).

When Perry and Lindell (2007) summarize eight features of the emergency planning process to improve community preparedness, deliberative public participation in the process is not among them. This is not to imply by any means that there is not a role for the public in emergency planning; quite the opposite: LEPCs and emergency planning throughout the country have benefit greatly from participation by formalized groups such as community emergency response teams (CERTs), informal citizen committees, and interested individuals. However, the broader challenges for effective public participation in LEPCs, and emergency planning in general, require that special attention be paid toward ensuring that the public are effectively represented by those who can advocate on behalf of their interests (Davidoff, 1965; Vatn, 2009).

Thus, given the nature of emergency planning and the challenges described above for planning participation, it can be expected that emergency planning organizations have a predominantly technically rational approach to the planning process and information selection. However, regulation and guidance now encourage some degree of communicative approaches to planning. There is evidence that diverse participation in planning can have positive outcomes, but barriers inherent to emergency planning inhibit participation by a broad range of community stakeholders, confining it rather to a narrow range of stakeholders from emergency response and management agencies, other government agencies, and industry. To the degree that increased

stakeholder participation engenders selection of different types of planning information, this can perhaps be extended to an emergency planning context for these stakeholders.

2.4.2.3 Measuring participation

Given the wide range of studies that describe participation, its benefits, and limitations, a question that follows is: How can participation be measured? Based a review of a 'representative' selection of planning participation literature (Arnstein, 1969; Brody, et al., 2003; Frame, Gunton, & Day, 2004; Hanna, 2000; Innes, 1996, 1998; Koontz & Johnson, 2004; Margerum, 2008; Reed, 2008), Table 1 lists potential measures of planning participation. While many of the potential measures of participation listed in Table 1 are very specific, others are more general. The measures are categorized according to the nature of the process, its management, methods, participants, goals and objectives, and outcomes. Some measures have been used by the respective authors to analyze or evaluate participation, but more often the measures listed in Table 1 are based on those authors' reviews of the literature and descriptions of planning contexts and processes, or research questions, analyses, and outcomes. The measures of participation are not intended to be exhaustive but rather representative of the wide array of variables that might be used in participatory planning research.

Of course, a significant challenge for researchers is actually utilizing participation measures in empirical studies of planning practice. As with this study, researchers are often limited by available data and resources to using less-direct or more-general measures of participation. However, as research on participatory planning

continues, specific assessments can help address gaps in empirical evidence for

participatory planning.

Table 1. Potential measures of participation.

Nature of Process
- *Impetus:* self-designed/originated by participants (3); local concern about issue/activism (9); regulatory framework/mandates (1,2); enforcement of regulatory mandates (2)
- *Phase:* role of participation in different phases of planning process (8)
- *Resources/limitations:* community resources (2,8); social capital (1,2,3,7,8); intensiveness of process (9); available time, effort, and resources (2,7); level of resources provided (1,2)
- *Scope:* scale of effort (8); distance/area of study (8); time horizon (1,5)
- *Setting/application:* institutional setting (8); planning application (5,7,9); specificity of application (2,5); appropriateness of approach to context (2,9)

Management
- *Attitudes:* support for participation (3,4); expectations of planners (1,2); flexibility of coordinating organizations (8); equality of citizen treatment (1,9)
- *Control:* who directs (8); use of facilitators/consultants (2,3); amount of facilitation (3,9); ownership of process (9); role of planners (5); staff management of participation program (2); staff expertise in participation (1,2); cooptation (1)
- *Effort:* intensity of engagement (1,4,8); effort for engaging participants (2); opportunities for citizen participation (2); number of personnel for effort (2); number of meetings (2)

Methods
- *Format:* methods of participation (1,2); technique (2,5); structure and consistency of forum (4); format of participation (2,3); continuity of participation (2); direction of participation (1,2); approach, e.g., top-down/bottom-up (1,2,7); form of communication (6); rhetoric of communication; notification/invitations for planning (2); inclusiveness (3,5); compensation of participants (1); appropriateness of format for solving planning problems (8,9); availability of other decision-making methods (3); legitimacy (7); clarity of rules/game-plan (2,3); use of guidance (2,5)
- *Level/type of participation:* roles of participants (1,4); voluntary nature of participation (3); centrality/influence of participants to the planning process (1,4); specific activities using participation (8); phase of involvement (9); timing/stage of participation (2); type of participation (1,2); nature of agreement, e.g., dissemination, consultation, etc. (1,9)

Table 1 continued. Potential measures of participation.

- *Use of information: process used to generate information (6); data dissemination (1,2,7); exposure to information (2,4); accessibility of information/dialogue (1); utilization of available information (2,9); use of different kinds of knowledge, e.g., scientific/local, types (2,6,9); quality of information (2,3)*

Participants

- *Abilities:* processing of information (4); networking (8); understanding of planning problem (8); knowledge, understanding, and skills of participants (1,2,3); learning process of participants (9); creativity and innovation (2,3)
- *Attitudes:* cooperation and coordination among participants (1,4,7); commitment to problem solving (8); support for process (3); buy-in of participants to the process (3); trust of participants in process (1,2); commitment to principled negotiation (3); fatigue of participants with process (9); incentives for collaboration (8); agreement about data (3), agreement about objectives (9)
- *Concerns:* stake in problem (8); objectives and interests (3); benefits to participants (9); motivation for participation (2,8); expected outcomes (8); justification for participation (2);
- *Power/authority:* pathways of influence (8); balances of power (1,3); power of participants (1,2); equality of opportunity/resources (1,3); strength of coalitions (1,8); rights of participants (1); flexibility (3); accountability (1,3); influence/charisma of participants (8)
- *Representation:* breadth of participants (2,4); heterogeneity of participants (9); number of participants (2,8); types of participants (2,4); representativeness (1,4,8); organizational affiliations (8); group type (7)
- Resources and limitations: planning resources (1,8); time available (1,3)

Goals/Objectives

- *General:* objectives of participation (1,2); number of planning objectives (2); personal transformation (7); redistribution of power (1)
- *Consensus:* level of compromise (4); goal of participation, e.g., consensus (3)
- *Representation:* representation of public interest (2,3)

Outcomes

- *Implementation:* approval process (5); commitment to implementing plan (3); influence on decision-making (1,9)
- *Perception:* perception of outcomes, e.g., success, conflict reduction (3)
- *Results:* types of outcomes (7); enforcement of participation requirements (2); durability of outcomes (2); spin-off efforts (3)

Sources are indicated as follows: (1) Arnstein, 1969; (2) Brody, Godschalk, & Burby, 2003; (3) Frame, Gunton, & Day, 2006; (4) Hanna, 2000; (5) Innes, 1996; (6) Innes, 1998; (7) Koontz & Johnson, 2004; (8) Margerum, 2008; (9) Reed, 2008.

2.5 Planning Participants

The literature review in the previous section identifies that the activity of planning is carried out by the participants in the process. While planning theorists and literature advocate for public participation in planning, it can be difficult to achieve in practice. This means that those with key roles in planning must be adept at engaging the public, and at representing public constituencies that, whatever the reasons, are not active participants in planning processes. Thus, planning participants who are involved in the planning process take on special influence and importance for the way the process is conducted and planning outcomes.

This section reviews literature about the interpretive frameworks of planning participants. Within the planning process, the transformation of static planning information into dynamic knowledge requires that information be processed through the interpretive frameworks of planning participants. These interpretive frameworks operate at individual, group, organizational, institutional, and societal levels. This study takes a perspective that the behavior of individuals can be interpreted by understanding their roles in societal structures including but not limited to organizations or institutions, and the norms that operate in such structures (Bates & Harvey, 1986). More specifically, the contexts of higher-order social-cultural frameworks and the settings or situations in which information is used influence the information behaviors of individuals through the norms, values, and conventions (Byström, 2007; Choo, 2007; Vatn, 2009) that are embedded in these higher-level contexts. Byström notes:

A socio-cultural perspective emphasizes context and the individuals' appeal to conform to the context they interact within. The focus is on relationships between people in groups or communities of practice that over time form, sometimes documented but more often unwritten, norms of appropriate ways to (re)act. Individual members are adapting to more or less exclusive memberships and within each to various roles that they either take or are given, accepting, often unconsciously, the convention of the role(s). Within the socio-cultural perspective in information studies the context is always seen as prior to the individual in defining and explaining actions [sic] (Byström, 2007, para. 17).

This framework is consistent with a "small-world" perspective of social theorists. In this perspective, small-worlds of traditional societies with distinct territories promote high degrees of self-sufficiency, shared beliefs, and understanding of the order of existence. In modern settings, this framework is observed in institutions in which people play specific roles. These institutional spheres have greater influence on individuals' strategic choices with significant repercussions than do individual spheres that allow for greater choices with less significant repercussions. Since occupations are dominant indicators of status in modern society, "the work-world has become central for 'establishing' [man] in many of his other life-worlds in and outside the institutional spheres" (Luckmann, 1970, p. 594). Within this work-world, organized professions have requirements for membership, and when membership is obtained, professional membership is a mechanism for social and economic mobility (Austin, 2002). Thus, institutions of occupation have very strong influences on individuals.

Small-world theory extends to the study of information behavior for culturally and intellectually similar people a number of settings (Chatman, 2000; Huotari and Chatman, 2001). According to Huotari and Chatman,

"…those things that hold this [small] world together include a common assessment of information worthy of attention, social norms that allow its members to approach or ignore information, and behaviors that are deemed acceptable by other inhabitants to be appropriate for this world" (Huotari & Chatman, 2001, p. 352).

A concept of social types is key for explaining the entry of information into small-world boundaries. Small-world theorists draw from Merton's (1972) concept of "insiders" and "outsiders." In this concept, insiders are members of specified groups and have privileged or trusted knowledge or truths, and outsiders are non-members who lack such knowledge or truths. Merton argues that while such conceptions do not account for values and interests of all individuals in different social type constructions, they do provide "for patterned differences, on the whole, between the perspectives of members of different groups or occupants of different statuses" while allowing for "a range of variability in perspective and behavior among members of the same groups or occupants of the same status" (Merton, 1972, p. 351).

Taylor (1991) presents an essay that is utilized in many subsequent studies on information behavior. Taylor describes the importance of context and setting in information use environments and focuses on the influences on different sets of people that affect their information use behavior. He describes that sets of people can be

understood in terms four types of classes: professions, entrepreneurship, special interests, and socioeconomic groups. Of these, the first two classes are especially relevant because of the common problems that they face.

Taylor defines problems in terms of the types of information that are required and characteristics such as problem structure, complexity, assumptions, and decision-making patterns. The settings in which sets of people and types of problems are found can be described by organizational roles, domains of activity, access to information, and history and experience. Taylor then explains how different types and amounts of information that different sets of people value, and that are actually needed to help resolve problems, influence the resolution of problems. As examples, Taylor compares characteristics and information use behaviors of three types of professionals and their associated problems: engineers, legislators, and physicians.

Choo (2007) reviews three case studies of information-seeking behavior in public and private organizations. His findings suggest that organizations and their associated information behaviors can be characterized in terms of distinctive epistemic styles that both shape and are shaped by the organization's belief selection strategies. These strategies can include justificationist, dogmatic, falsificationist, and other approaches. In justificationism, the organization has a strong culture of rules and routines, while in dogmatism, the organization has a culture of "knowing it is so." Falsificationism on the other hand allows for criticism of existing knowledge and looking for arguments against conventional beliefs. Justificationism and dogmatism can lead to rejection of new information, while falsificationist perspectives can more readily incorporate new

information. Choo contends that organizational values, norms, and practices influence information behavior. Of these, norms—accepted conventions about expected behavior—have the most direct impact in information selection and use. Values—beliefs about identity and agency—influence perspectives about the role of information in the organization, while practices—repeated patterns of behavior—affirm roles, structures, and interactions in organizations. Choo found that organizations develop information cultures based on their norms, values, and practices, and may adopt a satisficing approach to information seeking which results when the information search is considered to be "good enough." Choo describes the roles that different types of members have in their organizations and how roles affect information behavior. Those with managerial or technical backgrounds tend to adopt justificationist or dogmatic approaches, while more scientific types are open to falsificationist perspectives.

Thus, when multiple individuals in a common social structure share similar interpretive frameworks, they tend to generate similar knowledge. In social structures where interpretive frameworks vary, the knowledge generated from the same information may differ as a result of increased diversity (Grundstein, 2009). That is, people in different institutional contexts may have very different rationalities (Vatn, 2009). Those who engage in public planning efforts bring with them the cultures and norms of the community and organizations they represent—they 'stand where they sit' (G. Allison, 1971; Kleindorfer, Kunreuther, & Schoemaker, 1993). Organizational mechanisms (Boehm & Litwin, 1997; Faludi, 1971; Sager, 2001), ideological backgrounds and preferences (Fritsch & Newig, 2007), areas of specialization (Lindell &

Perry, 2001), and professional education (Boehm & Litwin, 1997) influence the implementation of rational activities in planning. Differing occupations can attract individuals with distinct personality traits (Holland, 1997). This is reflected in predispositions to varying decision-making approaches (Cloud, 2008; Fernandes & Simon, 1999; Johnson, 2006; Sager, 2001) such as information selection.

The literature review clearly makes a case for considering information behavior from a professional and organizational socio-cultural framework being grounded in cross-disciplinary theories from sociology, information science, and organization science. This framework presumes that different types of institutions (e.g., professions and organizations) have different social norms, values, and practices that shape the behavior of their members. Because planning participants are embedded in professions and organizations and they are thus predisposed toward different types of information and methods of obtaining it (and generally toward planning processes), an understanding of these differences can lead to better planning. Specifically, decision-makers can benefit from understanding how planning participants and their perspectives affect disaster planning processes, including planning for technological hazards (Kartez & Lindell, 1987). The focus of this research is on the effects of two different types of stakeholders—community planners and HazMat emergency responders commonly affiliated with fire departments—on a particular aspect of the emergency planning processes—the selection of planning information. These particular types of stakeholders are discussed below.

2.5.1 Community planners

Community planners, a type of professional, work in local planning agencies, a type of organization. Community planners work with residents, businesses, and local organizations and seek ways to plan for viable and sustainable communities. To be successful, community planners require diverse skill sets (Rabinovitz, 1967) that include understanding urban systems and design, analyzing information, developing and evaluating plans, including diverse stakeholders in planning, resolving conflicts and working with the public, knowing about regulatory and legislative issues, envisioning alternatives, and integrating economic, social, and environmental concerns (APA, 2011).

The literature indicates both a technical and communicative role for community planners. Bolan notes that "city planning in the broadest sense is a social process" (Bolan, 1971, p. 386) in which plan production is never purely technical, but organizing and communications skills are also needed. Howe (1980) analyzed the role choices of 577 public planning professionals who were members of the American Institute of Planners (later the American Planning Association) and classified 51% as hybrids between technicians and politicians, whereas 27% and 18% were classified specifically as technicians or politicians, respectively. Howe and Kaufman (1981) used the same sample to identify significant social background and professional setting factors with attitudes toward five different planning areas. For most of these areas, political views, professional role, and professional position were the most frequently identified factors of statistical significance. Planners in the Howe and Kaufman study have the most

consistent attitudes toward mass transit and the environment, but were less consistent in attitudes toward development, low-income/minority issues, and citizen participation.

In discussing course requirements for planning students and a normative set of skills that planners should have, Kaufman (1987) describes that planners should be trained as strategists, boundary spanners, and ethicists. Planners need strategic thinking skills to develop the best planning alternatives and conceptualize how to implement them in the political realities of public policy formation. Boundary spanning involves reducing opinion distances between planners and those they interact with through communication, persuasion, facilitating, resolving conflicts, negotiating and bargaining, mediating, and mobilizing. The field of planning ethics suggests that planners utilize their values obtained through upbringing, education, and experience. Planning should be done to "win in the 'right' way – i.e., not playing dirty or trying to 'win at all costs'" (Kaufman, 1987, p. 112), but Kaufman observes that planners do not necessarily share the same ethical frameworks.

On the other hand, Matthews (1993) surveys 100 U.S. land use planning practitioners and academics and finds that nearly 80 percent of informants share values oriented toward an ecological-preservation ethic or general preservation ethic. He indicates that personal socialization factors of age and membership in outdoor organizations are positively related to having a land resource ethic, and that professional socialization factors of education and work experience are most significant and positively related to a land resource ethic.

Dalton (2007) uses data from a survey of planning professionals to identify that planners are frequently involved in both community interaction and data analysis. In another study of 638 California planners, Guzzetta and Bollens (2003) find that those in planning professions and closely affiliated fields tend to rate communications skills as more important than technical skills.

In a survey of 256 planners from different parts of the U.S., Johnson (2006) reports that being certain types of planners (long-range planners, historic preservation planners, and urban designers) are positive and statistically significant predictors of having values of "civic bureaucrats," or community facilitators who value deliberative democracy. Other types of planners also have positive relationships with civic bureaucracy values (with the exception of technically focused Geographic Information System or GIS planners), although these other predictive relationships are not significant. Johnson finds that even in cities with low public engagement in community and planning activities, planners are oriented toward promoting public participation.

Kuhn and Nelson (2002) study group conflicts among 24 members of an urban planning organization that was undergoing reorganization. Although they report different attitudes and perspectives toward change among administrators, planning coordinators, technicians, and support staff, their results suggest a shared interest in enhancing planning quality and consistency. Planning coordinators—those who have the majority of contact with others in the community and thus likely represent the public's understanding of what a planner is—cite political and social skills as being especially important for interaction of planners with others in the community. Planning

coordinators are likely to identify strongly at work group, division, organization, and professional levels.

Lammers and Barbour (2006) use an institutional perspective and results from the study by Kuhn and Nelson (2002) to illustrate the common framework of urban planners. They describe that urban planning "is characterized by constellations of established practices guided by formalized rational beliefs that transcend particular organizations and situations" (Lammers & Barbour, 2006, p. 368). As such, urban planning organizations adhere to sets of rules, tend to have slow rates of change, and have roles that promote successful boundary spanning, while urban planning as a profession has "professional norms and doctrine [that] exert important external influences on the planner" (Bolan, 1971, p. 389).

Hence, community planners fill a multiplicity of roles, including both analyzing technical data and facilitating community and political interaction. Studies point specifically to the role of community planners in working with data. A workshop review of 50 social planners and analysts in 1975 by Hemmons, Bergman, and Moroney (Hemmons, et al., 1978) identifies that the highest percentage of planner and analyst time was spent on tasks such as coordinating data, analyzing data, using logical and systematic thought, and interviewing and interpreting data. More than 90 percent of social planners and analysts felt they were capable of performing these tasks.

A survey of 85 graduates from Massachusetts Institute of Technology's planning program between 1960 and 1971 (Schön, Cremer, Osterman, & Perry, 1976) identified that writing and synthesis of large amounts of material were the skills most frequently

cited as very important (81% and 69% of the sample, respectively), while interaction with politicians and community organizing also ranked high (62% and 43% of the sample, respectively). Of the sample, 38% rated information retrieval skills as very important. In addition, clusters of general planning skills such as writing, synthesis, interaction, consulting, and research design were valued by 44% of the sample, while clusters of specific information skills and quantitative skills were valued by only 15% and 9% of the sample, respectively.

Thus, the results of these studies suggest that community planners and community planning organizations exhibit common values and norms and can be expected to exhibit communicatively rational approaches to planning and information selection in the planning processes.

2.5.2 Emergency responders

Emergency response professionals work in emergency response agencies or organizations. Emergency responders include specialized personnel such as HazMat incident commanders and HazMat incident response teams. These types of personnel are typically housed in fire departments or, less frequently, are established as separate response teams with operating procedures and organizational cultures similar to those of fire departments. Fire departments are characterized by having a strong centralized "command and control" structure (Donahue, 2004) that enables them to provide rapid delivery of fire protection services and effective fire response (Archer, 1999; Grant & Hoover, 1994). This type of structure favors a one-way flow of information from the top down, with little inclusion of lower ranks in planning processes. These characteristics

make fire departments highly effective in emergency response operations. Not surprisingly, firefighters often prefer technical approaches to meeting their organizational missions and addressing organizational problems. However, their focus on short-term missions is not oriented, for example, toward long-term planning problems such as recovery from fire events, and command and control management has been described as poorly suited for collaboration with other agencies and the general public (Cloud, 2008).

Several studies investigate the temperaments of personnel in fire departments. Geldbach-Hall (2006) conducts a personality inventory of 250 firefighters in Clark County, Nevada, including line (Firefighter and Engineer) and supervisor (Captain and Battalion Chief) levels. Overall, nearly 80 percent of the firefighters had a "guardian" temperament, which Geldbach-Hall reports is nearly twice that of the general population based on a review of the literature.

Fannin and Dabbs (2003) compare preferences of firefighters for firefighting versus emergency medical services (EMS) work in DeKalb County and Atlanta, Georgia, and report that lower levels of openness and agreeableness are significant predictors of preference for firefighting work, and that higher levels of extroversion and lower levels of openness are significant predictors of enthusiasm for firefighting. Fannin and Dabbs (2003) find that lower levels of communion are significant predictors of preference for firefighting work over EMS work. The term communion refers to being in tune with others, and is manifested in contact, openness, and union (Bakan, 1966). Archer (1999) investigates firehouse cultures in the U.S., U.K., and Ireland. He finds

that group norms are a dominant feature of fire departments and conformity is required of newcomers, with penalties of exclusion and isolation for nonconformists. Archer's research suggests a very strong organizational culture oriented toward uniformity, with less tolerance for perspectives of "outsiders."

The characteristics of firefighters and fire department organization members relate to information behavior in several ways. Geldbach-Hall's (2006) study on firefighter personalities indicates a dominance of "guardian" temperaments, and the author references literature describing guardian temperaments as needing details to obtain a grasp of the facts, and wanting to make decisions about what they see. They live within constraints of rules or traditions of their organization or group. She suggests this makes it difficult to inject new ideas and systems into the fire services. Geldbach-Hall's (2006) review of the literature describes guardian personalities as watchful of outsiders, functioning as societal gate-keepers, and suspicious of new information. In describing traits of different personality types for military planning, Danikowski (2001) suggests that guardians are comfortable with established, calculable procedures and processes.

Lower levels of openness and agreeableness and higher levels of extroversion in firefighters compared to EMS responders in Fannin and Dabbs' (2003) study have implications for information selection. Lower openness (higher conservativeness) has been associated with preferences for documents that confirm previous experience instead of provoking new thoughts, using the least possible effort in seeking information, and preferring a few precise, conventional documents over a wide range of more exploratory

information sources. Low agreeableness (higher competitiveness) has been associated with having a lack of time as an information retrieval barrier, and also with skepticism. Extroversion has been associated with less systematic information searches, looking for quick solutions, and shallow rather than deep analysis of information (Heinström, 2003).

The studies by Geldbach-Hall, Fannin and Dabbs, and Archer (1999) suggest that firefighter emergency responders can be expected to exhibit narrower and more expedient information searches oriented toward confirming existing perspectives. Those in fire department organizations have traits that are well suited to technical analyses, but ill-suited to deliberative processes with a wide range of stakeholders who are sources of alternate information and perspectives from those in the emergency response culture, and where agendas and discussions that deviate from the organizational mission may be difficult to control. Thus, firefighter emergency responders and fire department organizations can be expected not to exhibit communicatively rational strengths in information selection and planning processes.

2.6 Planning Organizations

The preceding sections review the literature on planning participants, recognizing they are embedded in the social-cultural frameworks of institutions such as professions and organizations which have values, norms, and practices that influence participants' behaviors. The following sections review other aspects of organizations that are described in the literature regarding influences on organizational behavior, with specific attention to information selection and related behaviors.

2.6.1 Organizational tasks and information behavior

Tasks are those activities that workers engage in to accomplish organizational goals. The influences of organizational tasks specifically on information selection have been examined in a number of studies in the information sciences literature. Such studies, some of which are described below, generally assume a social-cultural perspective of organizations as influencing the context in which workers carry out tasks, consistent with literature described in Section 2.3. This organizational task literature is relevant to the present study because participants in planning organizations engage in planning tasks as they conduct planning projects.

Culnan (1983) studies the frequency of information source use by 392 professionals in a bank and a manufacturing company. She reports that use of written documentation such as periodical subscriptions and impersonal information from libraries significantly increased with task complexity. Culnan also finds that use of personal information sources from inside an organization and use of external sources from outside an organization generally does not significantly increase with task complexity across both organizations, with the exception of consulting peers as information sources. She also reports that frequency of use significantly increases for all types of information sources with increased accessibility, other than library sources.

Tiamuyu (1992) studies information source use and task complexity in Nigerian bureaucracies and indicates that increasing work complexity and decision-maker discretion has a significant positive effect on the number of information sources used. He concluded that low work complexity and decision-maker discretion induce civil

servants to emphasize information sources that are most immediately available, even if others are more appropriate (cf. Gerstberger & Allen, 1968 for similar results in U.S. engineers). Tiamuyu also describes that utilization of consultant reports compiled by experts are preferred in complex work activities, given their focus on immediate problems at hand and the exclusive organizational control of the reports.

Byström and Järvelin's study (1995), conducted in a public administration setting in a medium-sized Finnish city, suggests that use of internal information sources is highest for the least complex, most-formal organizational work tasks. As formality of tasks decreases, the need for fact-oriented information also decreases. As task complexity increases, the variety of information sources consulted increases, as does seeking of problem-solving information from subjective or expert sources (cf. Gorman, 1995 for similar results in U.S. physicians). However, the success of locating applicable information sources decreases, attributed to effort required to locate task-relevant information. Byström and Järvelin conclude that simple tasks need simple (fact-based, codified) information, and complex tasks need complex information. The use of internal sources remains high. Thus, increasing complexity of the work task leads to increasing information diversity. In addition, Pinelli et al. (1993) finds that formal information sources increase in perceived value to U.S. engineers and scientists as technical uncertainty and task complexity increase.

Byström and Hansen (2005) summarize the literature on relationships between information-intensive work tasks and information use, information source selection, and information strategy. They describe information use as an outcome of information

seeking, retrieval and collection of information, and implementation of information to accomplish the task or goal. Task performers seek information through different channels and sources and judge those avenues for their appropriateness. The ability to make this judgment is affected by task performers' knowledge and experience with information resources. The method or strategy used for seeking—more thorough or less thorough—can be impacted by the level of ambition of the information seeker. The professional setting of the work tasks affects the strategies chosen, and different professions can exhibit distinctive information-seeking strategies.

Byström (2002) examines information use in two Finnish local government organizations, and reports that people are increasingly consulted as information sources as the complexity of information tasks increases, and that their utilization is mostly as general sources of information, which may be either fact-based or subjective in nature. Documentary sources, which are primarily fact-based, initially increase in use as task complexity increases, but for the most complex tasks there is not an increase in documentary source use. This suggests a preference for people as sources of information, and some but limited utility of documentary sources. (Preference for people as information sources is consistent with observations of Janse (2006), whose survey results from 58 forest policy-makers indicates that peers are the most important information source for these decision-makers.) Byström's study also finds that both subjective and fact-based information are obtained from people inside organizations across the complexity of work tasks, but that fact-based information is sought from people outside the organization as task complexity increases. Byström concludes that

"as soon as information acquisition becomes an effort people as sources become more popular than documentary sources" [sic] (Byström, 2002, p. 589). Increasing perception of task complexity leads to increasing need for more types of information. The study involved minimal utilization of visits as sources of information, and corresponding outcomes are not reported.

2.6.2 Environmental scanning, boundary spanning

Environmental scanning is a means by which organizations identify potential threats and opportunities, using both formal and informal information-gathering techniques (Dozier & Ehling, 1992; Pflaum & Delmont, 1987). Environmental scanning is relevant to the present study because planning organizations respond to planning contexts—for example, perceived public and political support—as they engage in planning activities. In planning contexts, scanning the environment helps both public and private sector organizations reduce uncertainty and enhances their ability to think strategically (Pflaum & Delmont, 1987). Among the threats organizations may perceive through environmental scanning are political pressures (Pflaum & Delmont, 1987) or presence or activities of public groups (Dozier & Ehling, 1992) that can oppose the organization's activities.

Dozier and Ehling (1992) review literature on organizational relationships with the public and identify three types of public groups: a latent public, in which people face a common problem but are not aware of it; an aware public, in which people recognize they face a problem; and an active public, in which people organize to do something about a problem. Organizations can proactively manage their relationships with the

general public and try to prevent problems associated with active public groups by gathering information from and communicating with latent and aware public groups. This information seeking by organizations has a higher impact than simple processing of random environmental information as it is passively received, and then dealing with mobilized groups once they are active.

Dozier and Ehling (1992) point out that aware and active public groups seek out information. The authors review literature that indicates the public's level of information seeking varies greatly by the degree of involvement and perception that something can be done about a problem. Most people perceive that their ability to do something about problems is constrained, and they exhibit lower levels of information seeking and active behavior. A small minority of the public exhibits high involvement when facing perceived problems. This group has a much higher level of information seeking and active behavior.

Related to public awareness are relationships of organizations with the media. In theory, media coverage shapes public perceptions about which issues are important and which issues are not. However, studies suggest that the media has a lower impact on public opinion than might be expected (Kingdon, 1995; Liu, et al., 2010), limiting an organization's ability to use media to communicate desired messages to the right audience (Dozier & Ehling, 1992).

Boundary spanning relates to environmental scanning and is a process or mechanism by which organizations interact with their environments (J. S. Adams, 1980), such as other organizations or community members, through formation of networks and

searches for information. It can occur across physical, organizational, disciplinary,

personal, and informational boundaries (Brody, 2003a; Kaufman, 1987; Warner, Lulofs,

& Bressers, 2010; White et al., 2010). Thus, boundary spanning is another means by

which organizations can obtain information, and identify threats and respond to them.

While all organizations can have boundary spanning functions, specific institutional

forms relate to behaviors of "boundary organizations," such as centers that allow for

decision-making and action while overlapping different frames of reference and

organizational perspectives (White, et al., 2010). In this way, boundary organizations

internalize different frameworks and perspectives on both sides of a boundary, permit

maintenance of varying interests and norms, and provide a stable environment to

produce boundary objects that are mutually acceptable. Relevant literature (Warner, et

al., 2010; White, et al., 2010), describes boundary objects as shared elements across

organizations or communities that are used and viewed differently and can accommodate

the needs of each of group. In a community setting, public plans represent such a

boundary object.

Boundary spanning is considered key to the success of organizational decision-

making (Kaufman, 1987). For example Brody (2003a) finds that interorganizational

coordination is the strongest of five indicators of plan quality for 30 local ecosystem

management plans in Florida. White et al. (2010) use feedback from 308 water

management professionals through boundary spanning processes to improve water

resource modeling software in Arizona. Johnson, Pierce, and Lovrich (2011) report that

prevalence of boundary-spanning mechanisms in 344 U.S. counties significantly

increases collaboration in emergency management.

2.6.3 Other influences on organizational behavior

The preceding sections point to the importance of the concepts of work tasks,

environmental scanning, and boundary spanning in organization behavior. Several

studies describe other concepts that significantly relate to planning and decision-making

in organizations. These concepts include organizational activities, communication,

experience, innovation mechanisms, membership, motivations, resources, and structure

or formalization.

Webler and Tuler (2002) report on preconditions and moderating variables and

outcome variables that were important in their studies of environmental and natural

resources participatory planning in New England. The level of knowledge generated is

among the outcome variables that has a close linkage to information selection.

Organizational preconditions and moderating variables they describe can be classified

accordingly (with authors' original variables in parenthesis): organization and project

membership (density of formed interest groups, diversity of interest groups),

organization activity (other ongoing projects), boundary spanning (experience with in-

group-out-group communication, quality of social networks), and resources (physical

resources). Community preconditions and moderating variables (discussed in the

following section) are: economic basis (economic dependence of community), political

behavior (existing state of polarization, support from community leadership, consensus

on representation, legal constraints, presence of strong leaders), and community behavior

(support from citizenry, civic competence of participants, community autonomy, legacy of trust or distrust, litigiousness of climate), organization activity (other ongoing projects.

In their review of the literature, Perry and Lindell (2007) report that "LEPC size, subcommittee structure, meeting formalization, meeting frequency, role formalization, and computer technology contributed to positive [planning] outcomes" (p. 105). Whitney and Lindell (2000) find that effectiveness of Michigan LEPCs is significantly related to reward opportunity, role conflict, and evacuation experience among LEPC members. Organizations affect planning through their objectives (Brody, et al., 2003), goals, and expectations, and the resources they provide for planning efforts; e.g., funding, personnel, and support. The expected usefulness or utility of projects is a motivating factor in organizational decision-making, but other elements such as politics also affect decisions (R. V. Brown, 2000, 2006).

Bacharach and Aiken (1977) found significant positive relationships among communications in local government organizations, organization structure, boundary spanning, and decentralization. Staffing and structure and emergency planning resources have significant relationships with emergency planning outcomes in Michigan LEPCs as reported by Lindell and Meier (1994). Lindell and Whitney (1995) show that improvement in emergency planning outcomes for Michigan LEPCs is significantly related to team climate and LEPC association membership. LEPC staffing and structure are posited as acting through other primary relationships. LEPC use of automated

technologies is not significantly related to emergency planning outcomes in the Lindell and Whitney study.

On the other hand, Johnson, Pierce, and Lovrich (2011) use data from 344 counties and find that organizational investment in knowledge systems and professionalism are significant positive predictors of collaboration in local emergency management. Rogers and Sorensen (1991) and Rogers, Sorensen, and Morell (1991) report that community adoption of computer technologies is related to the professionalism, vicarious experience, and volunteer participation of emergency management agencies, and also find a possible relationship with available resources. They present technology adoption as an indicator of organizational innovation.

Organizational innovation concepts in E. M. Rogers' (2003) well-known explanation about how innovations are diffused in society indicate that champions are an important type of organizational member in support of new ideas and innovations, and their support can help overcome resistance to innovative ideas (E. M. Rogers, 2003). In fields of public planning and policy, champions can help promote new types of projects by networking across organizational boundaries and acting as knowledge brokers (R. Brown, 2004). When champions are successful, organizational behavior can change through adoption of new policies, procedures, and programs. Factors that can affect effectiveness of organizational champions include tasks, technologies, cultures, norms, and values of the organization and community, structures and governance, and formality (A. C. Taylor, 2010).

2.7 Community Influences on Planning

The preceding sections identify the role of information in the planning process and its characteristics, and the characteristics of planning participants and organizations as they influence information selection, plans, and decision-making. This section reviews literature on community characteristics as they affect planning organizations, participants, processes, and outcomes more generally. The perceptions of, exposure to, and experience with hazards and risks by the community and planning organizations (Burby, 2003; Peacock, Brody, & Highfield, 2005; G. O. Rogers, 1998; Templeton & Kirk, 2008) affect the perceived need for planning (McEntire & Dawson, 2007; Somers & Svara, 2009). These factors, experience with the planning process itself, and guidance or instruction used to facilitate planning are conceptualized as affecting the strategic choices made by planning participants in carrying out planning activities, including selection of planning information.

Lindell and Meier (1994) report that hazard vulnerability and community support has significant relationships with emergency planning outcomes in Michigan LEPCs. Lindell and Whitney (1995) show that improvement in emergency planning outcomes for Michigan LEPCs is significantly related to increases in resources provided by the state and community support. Hazard vulnerability, federal emergency planning resources, and state hazard assessment resources are posited as acting through other primary relationships.

However, Rogers, Sorensen, and Morell (1991), Lindell and Perry (2001), and Perry and Lindell (2007) cite works of multiple authors that show environmental hazard

management is a low priority for local governments due to conflicts with bureaucratic and political processes and because the probability of an incident occurring is low. Local resources are traditionally assigned to the demands of police, parks, and social services that people perceive as more pressing than hazard management. Local elected officials "often overlook or ignore risk, and resist allocating money for emergency management programs and activities" (McEntire & Dawson, 2007).

Lindell and Perry (2001) indicate that "chemical vulnerability analysis and chemical hazard management strategy formulation are both complex and unfamiliar demands on local government capacity." Brunet et al. (2001) suggest that "elected officials cannot know as much about the costs of delivering [fire] services as the agency personnel who actually deliver them" (p. 37).

Perry and Lindell (2003) identify that community size plays a role in emergency planning processes. "Larger communities—characterized by an elaborate structure of governmental offices, many resources and personnel, and perhaps higher levels of staff turnover—evolve formalized processes and rely more heavily upon written documentation and agreements. In smaller communities the planning process may generate few written products and be largely reliant upon informal, personal relationships for risk identification, assessment, and reduction" (p. 340). In their review of the literature, Lindell and Perry (2004) note that demographic factors which affect the decision-making of individuals for taking protective action from hazards and risks are "usually considered to be exogenous because they temporally precede virtually all other variables in models of hazard adjustment" (p. 160). However, the authors also describe

the equivocal importance of demographic factors in disaster response literatures, and indicate the difficulty of separating the effects of demographic variables because such variables tend to be highly correlated. These challenges notwithstanding, demographic variables related to community socio-economics that are often represented in the disaster response studies include but are not limited to education, income, and ethnicity.

Starik, Adams, Berman, and Sudharsan (2000) report locational effects in that LEPCs in lower populated areas, rural areas, and areas in the northeastern and southern regions of the U.S. are more likely to be out of compliance with planning requirements. LEPCs in areas with populations greater than 1,000,000 people have the highest rate of emergency plan completion. LEPCs in medium-density areas, urban areas, and in the Midwestern U.S. are more likely to be proactive. Regional differences in activities and operations of organizations that are key LEPC members such as fire departments (Paulsgrove, 2003) are also identified or suggested in the literature.

Attitudes and behaviors of political actors and community members also affect planning organizations and processes. Section 2.2.2.2 describes that political interest and support, as well as interest and support of the general public, have significant effects on the activities of LEPCs.

Johnson (2006) finds that community voting behavior affected the attitudes of civic bureaucracy among planners who were significantly impacted by the competitiveness of local elections, with greater competition promoting greater values of civicmindedness among planners. Higher levels of "government bashing" in the community significantly decrease values of civicness among planners. Another study by

Johnson and colleagues focuses on factors that affect collaboration in U.S. local emergency management agencies. Johnson, Pierce, and Lovrich (2011) used data from 344 counties and find that community attitudes and behaviors, such as prevalence of bridging mechanisms in a community over bonding (isolationist) mechanisms, are significant positive predictors of collaboration in local emergency management. Form of government, population ethnicity, and median household income are not significant measures in this study.

Other studies identify examples of community attitudes and behaviors that affect organizations and planning studies. For example, behavior of community members and peer groups has been described as affecting the overall behavior of organizations. Through processes of isomorphism (Diana & Olden, 2009; DiMaggio & Powell, 1983), organizations may seek to imitate the behaviors of their peers to increase appearances of legitimacy, because of uncertainty, or through professional affiliations.

2.8 Planning and Information-Seeking Models

Tying the relationships among the planning process, planning participants, planning organizations, and communities together sets the stage for the conceptual framework for this research on planning participants and information selection, and draws from other models described in the literature. Figure 2 illustrates a model that describes effective emergency planning (Perry & Lindell, 2007) and is alternately described as a model of effective emergency management (Lindell, Prater, & Perry, 2007). The model, which is based partly on research in LEPC effectiveness conducted by Lindell and colleagues in the 1990s, generally describes factors that relate emergency

planning (management) outcomes to community and organizational factors. These factors act through the planning process, which includes planning activities, team climate, situational analysis, and strategic choices. The planning process in turn affects both individual and organizational outcomes.
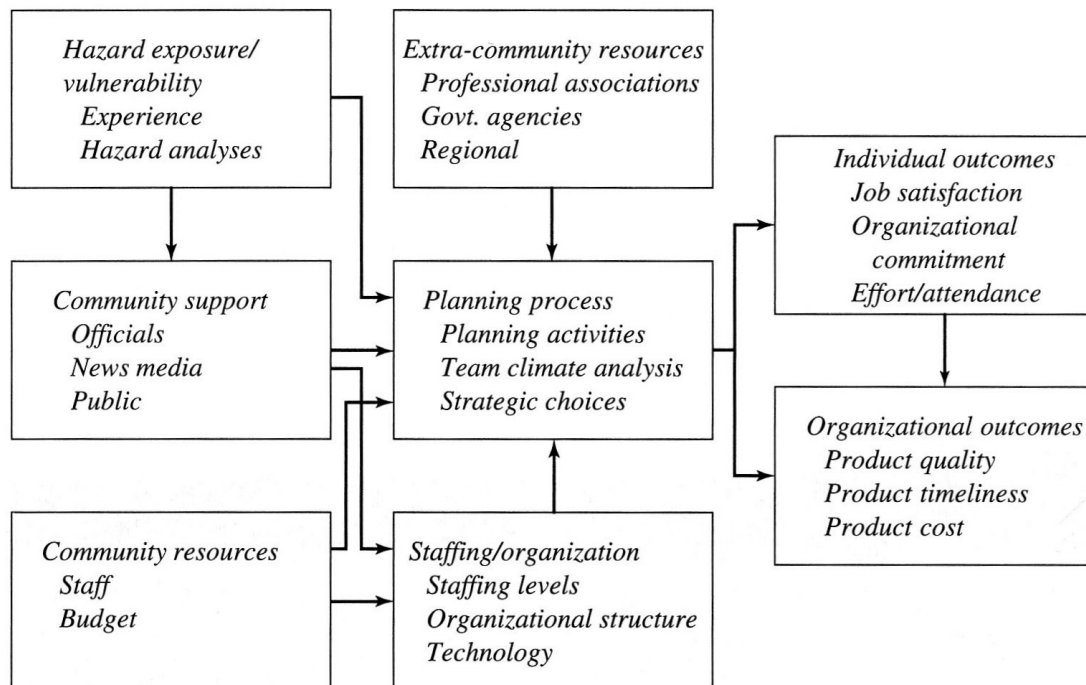
Figure 2. A model of effective emergency planning (Perry & Lindell, 2007). Reprinted with permission.

The specific focus of this research is the effect of planning participants on information selection, while controlling for the situational aspects of planning projects and the contextual aspects of planning organizations and communities. Figure 3 (adapted from Byström & Hansen, 2005) illustrates the relationships between context attributes, setting attributes, individual attributes, and information selection. In this

model, information seeking (the planning process) is directly affected by the attributes of

individuals (planning participants), which in turn are influenced by situational (planning

project) attributes and contextual (organization and community) attributes. This model

is consistent with the perspective of this research and the model of emergency planning

presented in Figure 2.
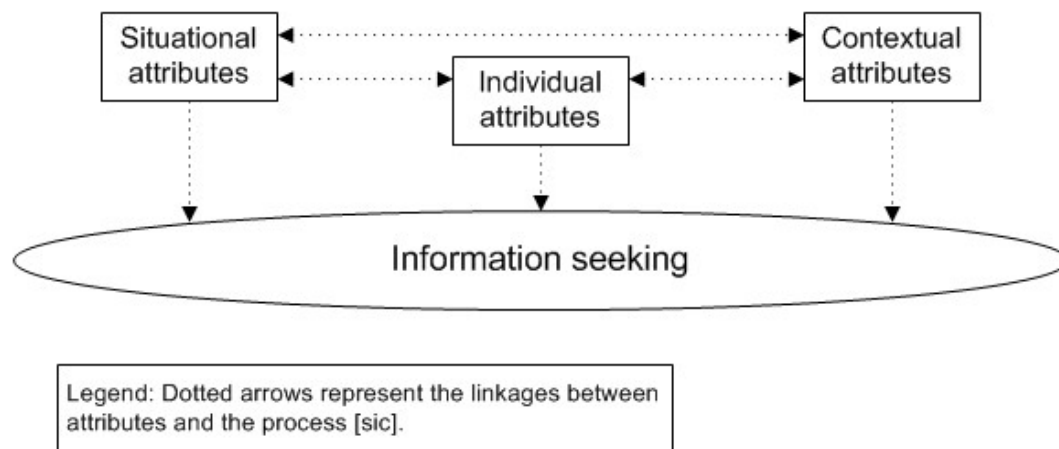
Figure 3. Information seeking and information attributes. Modified after Byström &
Hansen (2005) and reprinted with permission.

2.9 Summary of Literature Concepts and Sources

Based on the preceding review of the literature, Table 1 presents a summary of

the concepts and theoretical constructs in the literature associated with planning,

information, organizations, and communities, along with associated references. This

table only begins to scratch the surface of the literature on these concepts and constructs,

which has been studied from a variety of disciplinary perspectives. The concepts and

constructs presented in this literature review and in Table 2, however, are useful for

describing an initial conceptual framework for this research, which is described further

in Section 3.

Table 2. Concepts and theoretical constructs from literature and references.

Concepts and Theoretical Constructs	Literature References
Information	
Channels	Byström and Hansen, 2005
Satisficing	Choo, 2007; Simon, 1983; Warwick et al., 2009
Task descriptions	
Complexity	Byström, 2002; Byström & Järvelin. 1995; Culnan, 1983; Taylor, 1991; Tiamuyu, 1992
Discretion	Tiamuyu, 1992
Expediency	Choo, 2007; Gerstberger & Allen, 1968; Tiamuyu, 1992; Warwick et al., 2009
Formality	Byström & Järvelin. 1995; Gorman, 1995; Pinelli, 1993
Internal/external	Byström & Hansen, 2005
Knowledge/experience	Byström, 2002; Culnan, 1983; Tiamuyu, 1992; Taylor, 1991; Byström, 2002
Types	
Communicative	Corburn, 2004; Fritsch & Newig, 2007; Hoch, 2007; Innes, 1990, 1998, 2004; Wesselink & Paavola, 2011
Technical	Sabatier, 1978; McNie, 2007
Utility	Culnan, 1983; Mooers, 1996
Planning Participants	
Types of participants	Brody, 2003a; 2003c; Burby, 2003; FEMA, 2010; Perry & Lindell, 2007; Pearce, 2003; Schwab & Topping, 2010; Starik et al., 2000; Taylor, 1991; Templeton & Kirk, 2008
Socio-cultural frameworks	Allison, 1971; Archer, 2002; Bates & Harvey, 1986; Byström & Hansen, 2005; Byström, 2007; Choo, 2007; Kleindorfer et al., 1993; Merton, 2002; Taylor, 1991; Vatn, 2009
of emergency responders	Archer, 1999; Cloud, 2008; Donahue, 2004; Fannin & Dabbs, 2003; Geldbach-Hall, 2006; Grant & Hoover, 1994
of community planners	Bolan, 1971; Dalton, 2007; Guzzeta & Bollens, 2003; Hemmons et al., 1978; Howe, 1980; Howe & Kaufman, 1981; Johnson, 2006; Kaufman, 1987; Kuhn & Nelson, 2002; Lammers & Barbour, 2006; Matthews, 1993; Schön et al., 1976
Benefits of communicative/ participatory planning	Burby, 2003; Dietz & Stern, 2008; Forester, 1993; Healey, 1992; Innes, 1990, 1996, 1998, 2004; Koontz & Johnson, 2004; Leach, 2006; Leach & Pelkey, 2001; Selin et al., 2000; Wassen et al., 2011; Weeks, 2000
Limitations of communicative/ participatory planning	Altshuler, 1973; Ambruster, 2008; Archibugi, 2008; Brody, 2003c; Faludi, 1973; Fischer, 1991; Flyvbjerg, 1998; Leach & Pelkey, 2001; Munnichs, 2004; Rich et al., 2010; G. O. Rogers, 1992; Vatn, 2009
Lack of empirical evidence for participatory planning	Brody, 2003c; Burby, 2003; Dietz & Stern, 2008; Reed, 2008; van Asselt Marjolein & Rijkens-Klomp, 2002; Wassen et al., 2011

Table 2 continued. Concepts and theoretical constructs from literature and references.

Concepts and Theoretical Constructs	Literature References
Organizations	
Activity	Lindell & Meier, 1994; Lindell & Whitney, 1995; Paulsgrove, 2003; Perry & Lindell, 2007; Starik et al., 2000; Webler & Tuler, 2002
Boundary spanning	Adams, 1980; Bacharach & Aiken, 1977; Brody, 2003b; Choo, 2001; Johnson et al., 2011; Kaufman, 1987, Warner et al., 2010; ; Webler & Tuler, 2002; White et al., 2010
Environmental scanning	Choo, 2001; Dozier & Ehling, 1992; Pflaum & Delmont, 1987
Public awareness	Dozier & Ehling, 1992;
Experience and knowledge	Perry & Lindell, 2007; G. O. Rogers & Sorensen, 1991; G. O. Rogers, Sorensen, & Morell, 1991; Whitney & Lindell, 2000
Membership	Archer, 2002; FEMA, 2010; Merton, 2002; O'Leary, 1995; Perry & Lindell, 2007; Whitney & Lindell, 2000; Starik et al., 2010; ; Webler & Tuler, 2002
Motivation	
Agenda setting	Flyvbjerg, 1998; Kingdon, 1995; Liu et al., 2010
Project usefulness	R. V. Brown, 2000, 2006
Openness to innovation	E. M. Rogers, 2003; G. O. Rogers & Sorensen, 1991; G. O. Rogers, Sorensen, & Morell, 1991
Resources and technology	Brody et al., 2003; Lindell & Whitney, 1995; Perry & Lindell, 2007; ; Webler & Tuler, 2002
Structure and formalization	Bacharach & Aiken, 1977; Lindell & Meier, 1994; Lindell & Whitney, 1995; Perry & Lindell, 2007
Communications	Bacharach & Aiken, 1977; Lindell & Perry, 2001, 2004
Communities	
Attitudes and behavior	
Political	Brunet, 2001; Johnson, 2006; Lindell & Perry, 2001; Perry and Lindell, 2007; Rogers, Sorensen, & Morell, 1991; Somers & Svara, 2009; Webler & Tuler, 2002
Community	Beierle, 2003; Dozier & Ehling, 1992; Irvin & Stansbury, 2004; Lindell & Meier, 1994; McEntire & Dawson, 2007; Palenchar et al., 2005; Paton et al., 2010; Perry & Lindell, 2007; Rich et al., 1993; Roberts, 2004; Somers & Svara, 2009; ; Webler & Tuler, 2002; Wheeler, 2000
Economic basis, resources	Lindell & Perry, 2004; Starik et al., 2000; ; Webler & Tuler, 2002
Hazards and risk	Burby, 2003; Lindell & Meier, 1994; Lindell & Whitney, 1995; Peacock, Brody, & Highfield, 2005; G. O. Rogers, 1998; Templeton & Kirk, 2008
Location	Starik et al., 2000; Paulsgrove, 2003
Socio-economics	Hoard et al., 2005; Lindell & Whitney, 1995; McEntire & Dawson, 2007; Perry & Lindell, 2007

2.10 Gaps in the Literature and Need for Research

In summary, the review of the literature draws attention to relationships among the planning process, planning participants, planning organizations, and communities.

More specifically, it highlights relationships among information selection, planning participants, the planning setting, and planning context. Several questions follow due to gaps in the literature:

- Are constructs of major planning theories, such as communicative rationality, applicable to specific aspects of the planning process, such as information selection, and to domains such as emergency planning?

- Is the selection of communicative-oriented information sources affected by the types of participants involved in planning projects?

- Do the different types of planning participants and the values and norms of the organizations they represent affect strategic choices in planning processes?

- Is the breadth of information used in planning affected by the diversity of project participants?

Answers to these questions can help identify potentially promising practices for resource-constrained entities and provide guidance such as who to involve in planning and the types of information that are most beneficial for planning. They can also help inform federal guidance, regulation, and administrative processes about needs and recommendations to promote effective community and emergency planning practices.

Based on the literature, the anticipated answer to each of the above questions is "yes," but a lack of empirical evidence for planning settings and applications remains. The present study on LEPCs and local chemical hazards planning can help address the research gaps and answer these questions. Along with a limited number of other

empirical studies on communicative planning approaches, this study will contribute to

planning research and practice by examining the effects of specific types of planning

participants and the breadth of planning participation on information selection in the

planning process—an antecedent factor to knowledge generation, alternatives

identification, and resulting outcomes.

3. CONCEPTUALIZATION

3.1 Conceptual Model

The literature review in the preceding section draws attention to key theoretical concepts for relationships between the community planning process and the factors that influence planning activities. These concepts are summarized below.

The first factor that influences the planning process refers to characteristics of the <u>community</u> (and region), which provide the context for planning activities. Community context can be expressed through social, economic, and environmental variables such as resources (Lindell & Whitney, 1995; McEntire & Dawson, 2007; Perry & Lindell, 2007) which include a community's economic basis, the presence of and exposure to hazard and risk (Burby, 2003; Lindell & Meier, 1994; Lindell & Whitney, 1995; Peacock, Brody, & Highfield, 2005; G. O. Rogers, 1998; Templeton & Kirk, 2008), location such as state or region that the community is situated in (Starik, et al., 2000), and socio-economic demographics (Lindell & Perry, 2004). Political attitudes and behaviors (Brunet, 2001; Lindell & Perry, 2001; Perry and Lindell, 2007; Rogers, Sorensen, & Morell, 1991; Somers & Svara, 2009; Webler & Tuler, 2002) and community attitudes and behaviors (Beierle, 2003; Dozier & Ehling, 1992; Irvin & Stansbury, 2004; Lindell & Meier, 1994; McEntire & Dawson, 2007; Palenchar, et al., 2005; Paton, et al., 2010; Perry & Lindell, 2007; Rich, et al., 1993; Roberts, 2004; Somers & Svara, 2009; Webler & Tuler, 2002; Wheeler, 2000) are also characteristics of the community that can influence planning processes.

The second factor refers to characteristics of the planning <u>organization</u>.
Variables that can be used to describe the organizational context include organization
activity, boundary spanning, funding, innovation, knowledge and experience,
membership, motivation, resources, and structure (Adams, 1980; Archer, 2002; O'Leary,
1995; Bacharach & Aiken, 1977; Brody, 2003b; Brody, et al., 2003; Choo, 2001; Dozier
& Ehling, 1992; FEMA, 2010; Flyvbjerg, 1998; Johnson, et al., 2011; Kaufman, 1987,
Kingdon, 1995; Lindell & Meier, 1994; Lindell & Perry, 2001, 2004; Lindell &
Whitney, 1995; Liu, et al., 2010; Merton, 2002; Paulsgrove, 2003; Perry & Lindell,
2007; Pflaum & Delmont, 1987; E. M. Rogers, 2003; G. O. Rogers & Sorensen, 1991;
G. O. Rogers, Sorensen, & Morell, 1991; Starik, et al., 2000; Warner, et al., 2010;
Webler & Tuler, 2002; Whitney & Lindell, 2000). These variables can be applied to the
organization's behavior general and the way the organization engages in specific
activities such as planning projects.

The third factor refers to characteristics of planning <u>participants</u>. Because of the
scope of many planning efforts and the need to represent many different community
perspectives, normative participatory planning concepts as well as planning guidance
suggest that a broad and diverse group of stakeholders in the local community's safety
and security should be involved as participants. However, while there is some evidence
for positive effects of planning participation in practice (Burby, 2003; Koontz &
Johnson, 2004; Leach, 2006; Leach & Pelkey, 2001; Selin, et al., 2000; Wassen, et al.,
2011), increasing breadth of planning participants does not necessarily improve plan

quality or other outcomes, but it may instead be the type of planning participants that matter (Brody, 2003b).

Types of participants in planning processes differ by their community and organizational backgrounds, roles, experiences, communication skills, and perspectives (Brody, 2003b; Burby, 2003; R. S. Taylor, 1991). The participants who are engaged in community planning efforts bring with them the *socio-cultural contexts* of the community and organizations they represent (Allison, 1971; Archer, 2002; Bates & Harvey, 1986; Byström & Hansen, 2005; Byström, 2007; Choo, 2007; Kleindorfer, et al., 1993; Taylor, 1991; Vatn, 2009)—they 'stand where they sit'. For example, emergency responders (Archer, 1999; Cloud, 2008; Donahue, 2004; Fannin & Dabbs, 2003; Geldbach-Hall, 2006; Grant & Hoover, 1994) and community planners (Bolan, 1971; Dalton, 2007; Guzzeta & Bollens, 2003; Hemmons, et al., 1978; Howe, 1980; Howe & Kaufman, 1981; Johnson, 2006; Kaufman, 1987; Kuhn & Nelson, 2002; Lammers & Barbour, 2006; Matthews, 1993; Schön, et al., 1976) tend to have very different educational backgrounds and professional perspectives, as well as norms, values, and temperaments. Participants from some types of professions and organizations have predispositions to certain information sources (Heinström, 2003; R. S. Taylor, 1991) and decision-making approaches (Cloud, 2008; Johnson, 2006). Thus, different types of participants in planning processes affect how planning is carried out.

The fourth factor refers to the planning process, specifically, the strategy or approach used to deal with, manage, and solve problems. The planning process is influenced directly by the planning participants who are engaged in the process, and by

the characteristics of the community and the planning organization that act through planning participants and act directly on planning process as well. A predominant theoretical framework that has been proposed to deal with planning problems is communicative rationality Communicative rationality uses communicative and participatory approaches that are based on equitable participation among stakeholders and truth in deliberative decision-making (Braaten, 1991; Forester, 1993; Friedmann, 1987; Healey, 1992; Innes, 1996; Osawa & Seltzer, 1999).

Selection of planning _information_ is a foundational part of the planning process and is the basis for knowledge and alternatives generation (APA, 2010; Lindell, et al., 2007). The information that is used and the value placed on its importance will influence all subsequent steps in the planning process. *Types of information* include communicative information (Corburn, 2004; Fritsch & Newig, 2007; Hoch, 2007; Innes, 1990, 1998, 2004; Wesselink & Paavola, 2011) and technical information (Sabatier, 1978; McNie, 2007). Other important characteristics of information include its complexity, expediency, internality or externality, formality, and utility (Byström, 2002; Byström & Järvelin. 1995; Culnan, 1983; Gerstberger & Allen, 1968; Gorman, 1995; Mooers, 1996; Pinelli, 1993; Taylor, 1991; Tiamuyu, 1992). Rather than being synoptic, decision-making is bounded (Simon, 1983) by resources (e.g., time, budget, personnel, technology, etc.) as well as attention span and other cognitive process limitations. People and organizations often make decisions with only limited information (Liu, et al., 2010), including information from sources that are obtained expediently or because they confirm prior beliefs (Stern & Fineberg, 1996), and under various structures (G. O.

Rogers, 1994) that impact the outcomes. They 'satisfice' (Simon, 1983) to obtain the

minimum amount of required information that is most expediently available (Choo,

2007; Warwick, Rimmer, Blanford, Gow, & Buchanan, 2009). This suggests a potential

disconnect between what is recommended for emergency planning and what is

achievable in practice.

Relationships between information selection in the planning process and the

factors of community, planning organizations, and planning participants are illustrated in

the conceptual model for the research (Figure 4).

```
┌─────────────┐
│  Community  │────────────────────────────────────┐
└─────────────┘                    │                │
       │                           ▼                │
       │                  ┌─────────────┐   ┌─────────────┐
       │                  │  Planning   │   │ Information  │
       │                  │Participants │──▶│  Selection   │
       │                  └─────────────┘   └─────────────┘
       ▼                           ▲                ▲
┌─────────────┐                    │                │
│  Planning   │────────────────────┘                │
│Organization │─────────────────────────────────────┘
└─────────────┘
```
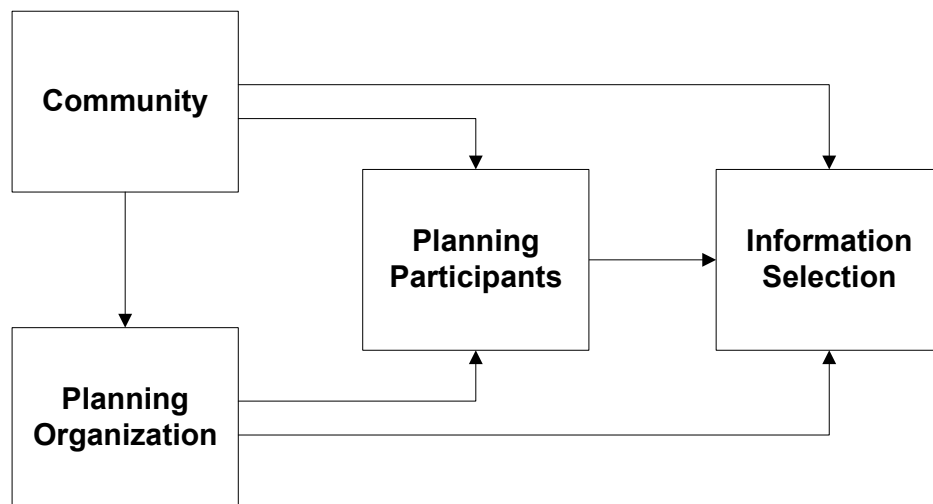
Figure 4. Conceptual model.

3.2 Hypotheses

The goal of this research is to better understand the effects of different types of

participants on information selection in planning projects. Two hypotheses relate

selection of communicative-based information with two different types of project participants— community planners and HazMat emergency responders. A third hypothesis relates the diversity of information selection with the diversity of planning participants. The research hypotheses are summarized in Table 3.

Table 3. Research hypotheses.

Planning Participants	Information Selection
+ Community Planners	H_{1a}: + Communicative Information Selection
+ HazMat Emergency Responders	H_{2a}: – Communicative Information Selection
+ Planning Participant Diversity	H_{3a}: + Information Selection Diversity

3.2.1 Hypothesis on community planners and information selection

Section 2.5.1 describes community planners' educational and professional orientations toward information gathering, quantitative data analysis, and communicative interaction with a wide range of stakeholders. Their participation in planning projects is expected to have a significant positive effect on the selection of communicative-oriented information.

To determine if the participation of community planners in planning projects does in fact relate to the selection of communicative information, this research will test the following hypothesis:

Hypothesis 1: The participation of community planners in planning projects will significantly increase the selection of communicative-oriented information.

3.2.2 Hypothesis on emergency responders and information selection

Section 2.5.2 describes that emergency responders, such as HazMat responders typically affiliated with fire departments and other public safety agencies, operate in organizations that tend to have top-down command and control management approaches. Firefighters themselves tend to have guardian temperaments, a personality type that seeks to live within rules or traditions of their own groups, and is comfortable with technical approaches and established, calculable (controlled) procedures. Traits associated with firefighter responders are lower openness, agreeableness, and communion with others, with organizational cultures oriented to conformity and less tolerance for perspectives of 'others.' Such tendencies would likely create challenges for the seeking of information through engagement with community stakeholders in two-way dialogues. Participation of emergency responders in planning projects is expected to have a significant negative effect on the selection of communicative-oriented information.

To determine if the participation of emergency responders in the planning projects does in fact relate to the selection of communicative information, this research will test the following hypothesis:

Hypothesis 2: The participation of HazMat emergency responders in planning projects will significantly decrease the selection of communicative-oriented information.

3.2.3 Hypothesis on planning participant diversity and information selection diversity

A broad range of community interest and participation is widely considered as beneficial to planning processes. Planning efforts for which resources and public interest are limited seldom suffer from the types of paralysis caused by too many participants as described in environmental and resource planning studies, and indeed, their legislative mandate calls for membership diversity. A more heterogeneous group will likely have different knowledge and ways of knowing that can influence selection of different types of information. Thus, a significant, positive relationship is expected between the diversity of planning project participants and the diversity of different information sources selected.

To determine if the breadth of participation in planning projects does in fact relate to the breadth of different information sources selected, this research will test the following hypothesis:

Hypothesis 3: An increase in the diversity of participants in planning projects will significantly increase the diversity of selected information.

4. RESEARCH METHODS

4.1 Research Setting

The Emergency Planning and Community Right-to-know Act (EPCRA) was passed by Congress in 1986 in response to the 1984 Union Carbide chemical disaster in Bhopal, India, and a near-disaster for a similar Union Carbide chemical facility the following year in West Virginia. EPCRA mandated the formation of local emergency planning committees (LEPCs), which are local-level organizations that are responsible for local chemical hazards planning and enabling community right-to-know. When Congress established the mandate for LEPCs under EPCRA, it established them as volunteer, multi-stakeholder organizations but did not provide federal funding mechanisms for LEPC operations—that is, LEPCs are largely an unfunded mandate for local jurisdctions. Many LEPCs receive nominal financial support through local governments and local industries. A small minority of LEPCs even receive substantial levels of non-federal funding through industry membership contributions or means. Some federal grant funds are also available to LEPCs, such as U.S. DOT's Hazardous Materials Emergency Preparedness (HMEP) Grant Program, distributed by state coordinators to LEPCs for conducting HazMat training and planning (tribes and other entities also receive HMEP funds). However, most LEPC resources (funds, facilities, time, personnel), are donated by their local constituencies. This means that LEPCs are under substantial time and resource constraints, increasing the importance of the voluntary and participatory nature of the organization. Nearly all LEPCs report resource

barriers for their organizations (G. O. Rogers et al., 2010) including lack of funding, time, or personnel.

LEPCs were established with mandates of broad community membership under EPCRA. LEPC membership is supposed to include:

- "Elected State and local officials;

- Law enforcement, civil defense, firefighting, first aid, health, local environmental, hospital, and transportation personnel;

- broadcast and print media;

- Community groups;

- Owners and operators of facilities subject to the requirements of [EPCRA]" (Emergency Planning and Community Right-To-Know Act, 1986)

In practice, LEPC membership consists mainly of government officials, emergency responders, and industry stakeholders (EPA, 2009b; Rich, et al., 1993) but it can also include other stakeholders. Entities that are not designated in EPCRA for minimum LEPC membership requirements, such as community planners, may also be part of the LEPC. Because of its multi-stakeholder framework, LEPCs can be characterized as a boundary organization that provides a setting for incorporation of diverse perspectives.

One of the components of required chemical hazards emergency plans is an assessment of the routes in the LEPC's jurisdiction by which HazMat is transported, but the means by which this is to be accomplished are not specified. An important type of

study that can help address this requirement is a hazardous materials commodity flow study (HMCFS), which describes hazardous materials movements over transportation networks into, out of, within, and through an area (ICF, 1995; G. O. Rogers, et al., 2010). An HMCFS is primarily focused on collection and interpretation of information, which can be used to provide 'environmental cues' about the nature of technological hazards due to transportation of hazardous materials in a community (Lindell & Perry, 2004). In this way, HMCFS are similar to environmental impact statements that function as 'information compendiums' (Innes, 1998).

LEPCs and HMCFS participants have a great deal of discretion over how they conduct HMCFS projects, within their organizational rules and codes of conduct, and requirements of funding programs and agencies. HMCFS are not a mandatory component of local chemical hazard plans, however, Rogers, et al. (2010) identified that HMCFS information supports a variety of different emergency and community planning objectives. Thus, an HMCFS can be a very important type of study for LEPCs and emergency planning organizations. Because an HMCFS can involve diverse participants and diverse information sources, it can function as a boundary object that promotes cooperation across organizational and professional boundaries and fulfills the different needs of different community stakeholders.

The importance of HMCFS for LEPCs is further evidenced in the role that information can have for reducing uncertainty (by providing answers to specific questions) and reducing equivocality (by clarifying which questions to ask) in emergency planning. Daft and Lengel (1986) identified seven structural mechanisms for

organizational decision-making. These mechanisms include rules and regulations (which reduce the greatest uncertainty), formal information systems, special reports, planning, direct contact, integrator, and group meetings (which reduce the greatest equivocality). The most prevalent structural mechanism utilized by LEPCs is group meetings, which enhances their ability to decide which questions to ask, but affords less ability to answer specific questions. Since the ability of LEPCs to set transportation rules and regulations is greatly constrained, and most if not all LEPCs lack the resources for formal information systems, this means that HMCFS, as special planning reports, provide the most-feasible means an LEPC has for reducing uncertainty about chemical hazards transport in the community. HMCFS information is also used in development and updates of local chemical hazard emergency plans, which provide a dual mechanism for reducing both uncertainty and equivocality. Additional information about LEPCs and HMCFS projects is provided in Appendix A.

The multi-stakeholder nature of LEPCs and the focus of HMCFS projects on planning information makes this type of organization and project an ideal setting for assessing the effects of planning participants on planning information selection. On one hand, HazMat responders are organizational insiders. They have a primary role in emergency operations planning and are identified by key federal emergency planning documents as members of core planning teams. However, aside from grouping them in categories of 'local officials' or similar constructs, emergency responders specifically are not the specific subject of previous empirical planning studies. This creates a unique opportunity to assess the role in planning studies of a type of local agency participant

that has especially strong command and control norms and preferences for technical problem solving approaches, as identified in the literature review.

On the other hand, community planners can be considered as 'outsiders' in the LEPC emergency planning context as they are not specifically named in EPCRA among the groups that should play a role in LEPCs, and since federal emergency planning guidance does not emphasize a lead role for community planners in the emergency planning process. If planners are participating in conduct of HMCFS, it is likely because of their interest in the project, LEPC organization, or community, because they were asked to participate, or because of the need of decision-makers for HazMat transport data. Thus, the present study offers a unique opportunity to assess the role of planners where they are most likely *not* in the lead organizational planning role. Further, this study offers an opportunity to evaluate the ways that community planners potentially contribute to emergency planning.

As volunteer-based organizations, LEPCs are especially dependent on the active involvement of their memberships to achieve organizational goals and mandates. This means that participation of multiple and different LEPC stakeholders provides critical manpower and other resources to conduct planning projects such as HMCFS. It also provides potential sources of planning data and perspectives that are important for communicative planning approaches. Thus, this study provides a good venue for evaluating the effects of planning participant diversity on the planning process.

Finally, HMCFS projects are focused on information. In most academic assessments of planning, the focus is on processes by which knowledge is generated in

the planning organization, or on planning outcomes such as plan quality or implementation of alternatives. However, few studies assess the selection of information that forms the fact-basis of planning. This makes this HMCFS an ideal setting in which to evaluate a key component of planning processes that has received little attention in academic literature.

4.2 Study Approach

This research is based on quantitative analysis of secondary data. The primary data source is a national survey of U.S. LEPCs about their conduct of hazardous materials commodity flow studies. The survey data is augmented with other secondary sources including *Census 2000* and *American Community Survey* data from the U.S. Census Bureau, the U.S. Department of Agriculture Economic Research Service's *2004 County Typology*, and community cost-of-living data compiled by City-Data.com. These data were analyzed using multiple linear regression and binomial logistic regression models.

4.3 Sampling

In the summer of 2008, an electronic survey of HMCFS practices by LEPCs was administered by Texas A&M University's Hazard Reduction and Recovery Center and the Texas Transportation Institute, a part of the Texas A&M University System. The survey was conducted as part Project HM-01 for the Hazardous Materials Cooperative Research Program, administered by the Transportation Research Board (TRB) of the National Academies, to update the guidance used by LEPCs and other local entities in the conduct of the HMCFS. The specific goal of the survey was to provide data to

inform the TRB project about LEPC 'best practices.' TRB has provided permission for use of the survey data for this research.

Development and distribution of the survey instrument was conducted using the Tailored Design Method (Dillman, 1999). The survey was pretested at the 2008 Midyear meeting of the National SARA Title III Program Officials in Charleston, South Carolina, and feedback from LEPCs that participated in the pretesting was incorporated into the finalized survey instrument design. The survey covered a wide range of issues concerning LEPCs, including whether and how the LEPC conducted HMCFS, HMCFS outcomes, and other topics such as community and political support, community demographics, and economic sectors. A copy of the survey instrument and a copy of the Texas A&M Institutional Review Board (IRB) human subjects protocol approval for the survey are provided in Appendix B and C, respectively.

The survey instrument was distributed to LEPCs by e-mail. Unfortunately, it is difficult to ascertain the population of active LEPCs. Appendix I.4 describes estimates of the LEPC population, including a national LEPC survey by U.S. EPA (2009a) that refers to more than 3,000 LEPCs of which 2,357 were identified as having valid e-mail addresses. However, a prior study conducted for EPA in the late 1990s identified more than 4,000 LEPCs (Starik, et al., 2000). The 2008 survey that provides the secondary for this research was distributed to LEPCs with valid e-mail addresses.

E-mail addresses were collected in April and May 2008 from a U.S. EPA listing of LEPC contacts, state emergency response commission (SERC) Web sites, and contacts with individual SERCs. E-mail addresses from the different sources were

compiled and compared to identify duplicate, incorrect, or incomplete email addresses. In total, the request for participation was sent to 1,856 valid e-mail addresses for LEPCs and Tribal Emergency Response Commissions (TERCs) in 36 continental U.S. states for which LEPC email contacts were mostly or totally complete. These states include: Alabama, Arkansas, Arizona, California, Delaware, Florida, Georgia, Iowa, Idaho, Indiana, Kansas, Louisiana, Maryland, Maine, Minnesota, Missouri, Montana, North Carolina, North Dakota, Nebraska, New Mexico, Nevada, New York, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, Washington, Wisconsin, West Virginia, and Wyoming.

Requests for LEPC participation in the survey were sent three times, on May 30, June 9, and July 29, 2008. The survey was closed on August 14, 2009. Four hundred and ninety-seven surveys were received from LEPCs in these states, resulting in a (497/1859=.267) 26.7 percent crude response rate.

For LEPCs in the remaining 12 continental U.S. states with no or limited LEPC email contact information at the time of the survey, a request for participation with a link to the survey was forwarded to corresponding SERCs for distribution in June and July 2008. Telephone contacts to SERCs were attempted to clarify the nature and purpose of the requests. The SERCs were requested by the researchers to forward the request for participation to LEPCs in their states. As a result 50 survey responses were received from LEPCs in six of the states: Colorado, Illinois, Kentucky, Michigan, Rhode Island, and Vermont. There were an 'expected' total of 484 LEPCs in these six states at the time of the survey, but it is not known whether this is the actual total number of LEPCs

in these states, or the total number of LEPCs that were sent or received requests for participation from their SERCs. Assuming all 484 LEPCs in these six states received the survey, the crude response rate would have been (50/484 = .103) 10.3 percent.

No survey responses were received from LEPCs in the remaining six states for which LEPC participation was requested from their corresponding SERCs, and it is assumed that requests for LEPC participation in the survey were not forwarded by SERCs. These states are Connecticut, Massachusetts, Mississippi, Hew Hampshire, New Jersey, and Tennessee. Since these six states failed to generate responses, the nature of the universe of LEPCs therein remains uncertain. Notwithstanding the six states from which no survey responses were received, the *maximum* response rate is 547 valid responses from unique LEPCs divided by 1,856 listed LEPCs plus the 50 responses received through distribution by the SERCs, or 547/(1,856+50) = 28.7 percent. The *minimum* response rate is the same 547 valid responses divided by the same 1,856 listed LEPCs plus 484 LEPCs that potentially received the request for participation from their SERCs, or 547/(1,856+484) = 23.4 percent. Hence the actual survey response rate is between 23.4 and 28.7 percent (G. O. Rogers, et al., 2010).

4.4 Research Sample

The research sample that is used for this study is comprised of a subset of the original survey sample described in Section 4.3. Only responses from entities that conducted HMCFS, and only responses provided by municipal, county, and regional LEPCs, and entities that did not provide identifying information (which are assumed to be LEPCs), are included in the research sample. One tribal emergency response

commission (TERC) reported conducting an HMCFS and this case is also included in the analysis. The number of LEPCs that indicated they had conducted HMCFS totals 280 cases. (The total includes the response from the TERC as noted above. For the purposes of this study, these cases are collectively referred to henceforth as those of LEPCs.) Thus, the unit of analysis is an HMCFS project that represents the most-recent such study conducted by an LEPC.

In order to measure the effects of HMCFS participants (independent variables) on HMCFS information selection (dependent variables) in HMCFS projects, it is necessary that both types of variables are present in the data. Of the 280 LEPCs that had conducted HMCFS, 64 did not provide responses about the selection of information sources, involvement of project participants, or both. These cases were excluded from the analysis.

It is also important that the responses are properly specified to minimize measurement error and introduction of biased variance into empirical analysis. Responses were quality checked to validate response coding. Next, responses were categorized by the year they were conducted (after 1998 or not) and by whether the LEPC or other entity (federal agency, contractor, or other) conducted the study to identify whether potential memory or experiential effects contributed to validity indicators. Textual responses that were provided to questions were also reviewed. When prompted for written responses to free-form questions, some informants indicated that the HMCFS was conducted by their LEPC 'before their time' or they were not

involved. Because it is important the data accurately reflect how the HMCFS was conducted, a total of 28 such cases are also excluded from the analysis.

Other informants indicated that they were 'unsure', the answer was 'unknown', or provided similar comments to free-form questions. Such comments are interpreted in two ways. One interpretation is that the informants were unaware of *additional* information. For example, when asked about which sources of existing data were used in their HMCFS, an informant might indicate that 'data provided by transport carriers' and 'hazmat accident/incident data' were used, as well as indicate that 'other' information sources were unknown. For such cases, the informant appears to have had sufficient knowledge about the HMCFS project to provide affirmative responses about specific aspects of the conduct of the project.

Another interpretation is that the informant was not sufficiently familiar with the HMCFS project to provide specific information about how it was conducted. For example, an informant might not indicate use of any information sources, and only indicate 'unknown' in text fields for 'other' information sources. For such cases, the informant appears to have had insufficient knowledge about specific aspects of the project conduct. The responses were carefully examined and categorized by number of 'unknown' type responses for 21 questions. Some allowance was given for a limited number of such responses, but a total of three 'unknown', 'unsure', or similar responses for a given case was used as a threshold to indicate limited informant ability to adequately provide valid responses. Of the remaining cases, there are a total of five cases at or beyond this threshold level, which are also excluded from the analysis.

A tabular breakdown of case inclusion and exclusion for informants based on the above-described criteria is provided in Appendix D, along with a listing of questions that were examined for response validity indicators. The table shows that of the 216 cases where the LEPC had conducted an HMCFS and provided information for the dependent and independent variables, 183 cases were retained, and 33 were excluded from the analysis. Thus, the remaining 183 cases that form the research sample are for those LEPC informants that conducted HMCFS and provided information about key independent and dependent variables, and whose responses did not suggest a substantial lack of knowledge about or experience with the LEPC's conduct of the HMCFS project.

4.5 Measures and Variables

Five sets of measures and variables are of relevance to this study. One set corresponds to the dependent variables associated with information selection, and includes measures of communicative information selection and information selection diversity. Another set corresponds to the independent variables associated with HMCFS participation, and includes measures of HazMat responders, community planners, and participant diversity. A third set corresponds to contextual factors associated with the LEPC organization, and includes measures of activity, boundary spanning, funding, innovation, knowledge/experience, membership, motives, resources, and structure. A fourth set corresponds to contextual factors associated with the community, and includes measures of location, economic basis, hazard and risk, socio-economics, and attitudes and behaviors. A fifth set corresponds to validity threats to outcomes of the study and includes measures of individual informant characteristics and survey administration.

4.6 Planning Information Measures and Representative Variables

The dependent variables of interest for this research are *communicative information selection* and *information selection diversity*. These variables are comprised of underlying variables associated with communicative information (CI) and different types of information diversity, respectively. The conceptual relationships among different HMCFS information sources are described in detail in Appendix A. The approach and outcomes of the principal components analysis that was used for creating indices of different information dimensions, including communicative information, are described in detail in Appendix E. Information selection diversity is measured using two underlying variables: number of different information sources that were selected, and the number of different types of information that were represented in the different information dimensions. The development of the communicative information selection and information selection diversity variables is described further in Sections 4.6.1 and 4.6.2, below.

4.6.1 Communicative information

Communicative information (CI) refers to:

- interviews with transport carriers;

- interviews with industry representatives; and

- interviews with emergency responders.

These variables were provided by the survey informants' direct response to the LEPC survey on HMCFS practices, and together, they indicate a dimension of communicative information that is obtained through interview processes, as described in

Appendix A. The ordinal *communicative information selection* variable was created by

a summation of these variables, to create an ordinal (0-3) scale. The principal

component analysis, reliability analysis, and construction of the CI selection variable are

described in Appendix E.3. The frequency distribution of the CI selection ordinal

variable is provided in Table 4 below.

Table 4. Frequency distribution of CI selection ordinal variable.

Number of Selected Communicative Information Sources	Frequency	Percent	Valid Percent	Cumulative Percent
0	94	51.4	51.4	51.4
1	54	29.5	29.5	80.9
2	24	13.1	13.1	94.0
3	11	6.0	6.0	100.0
Total	183	100.0	100.0	

The binary *communicative information selection* variable was created by an

evaluation of whether *any* communicative information sources were selected. The

frequency distribution of the CI selection binary variable is provided in Table 5 below.

Table 5. Frequency distribution of CI selection binary variable.

Communicative Information Source Selection	Frequency	Percent	Valid Percent	Cumulative Percent
No	94	51.4	51.4	51.4
Yes	89	48.6	48.6	100.0
Total	183	100.0	100.0	

4.6.2 Information selection diversity

In addition to communicative information sources as described above, four other types of information sources described in Appendix A are secondary technical information (STI, consisting of accident/incident data, data from industry, and data from transportation carriers), original technical information (OTI, consisting of vehicle/vessel counts and HazMat placard counts), non-local information (NLI, consisting of information from federal agencies, information from state agencies, information from the Internet, and Census/Bureau of Transportation Statistics data), and prior studies information (PSI, consisting of previous HMCFS conducted by the LEPC and HMCFS conducted by another agency). The secondary technical information and original technical information variables are also described further in Appendix E.3.

Information selection diversity is measured using two different but related variables. The information selection diversity variable is provided by the number of selected information sources, potentially up to 15 information sources as measured by the survey instrument (the maximum number of sources actually selected by LEPCs in the sample was 12). The second measure of information diversity is provided by number of selected information types, potentially up to five information types (CI, STI, OTI, NLI, and PSI). Histograms of these information selection diversity variables are shown in Figures 5 and 6, respectively.
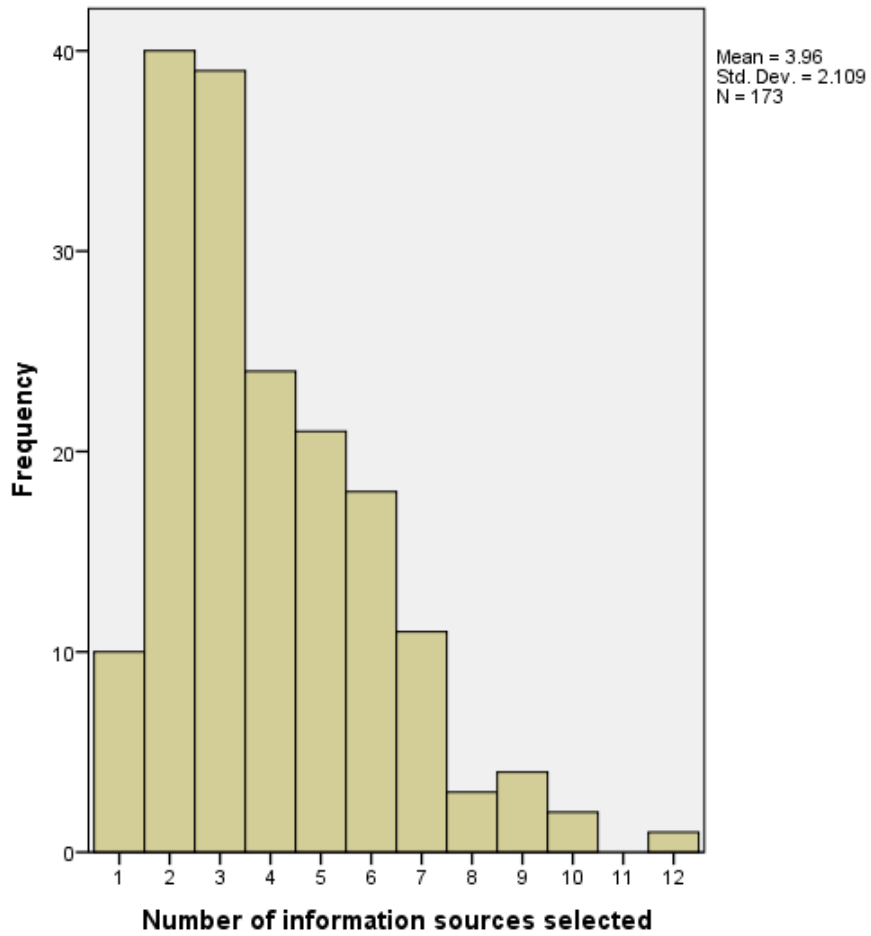
Figure 5. Information selection diversity: histogram of total number of different information sources selected.
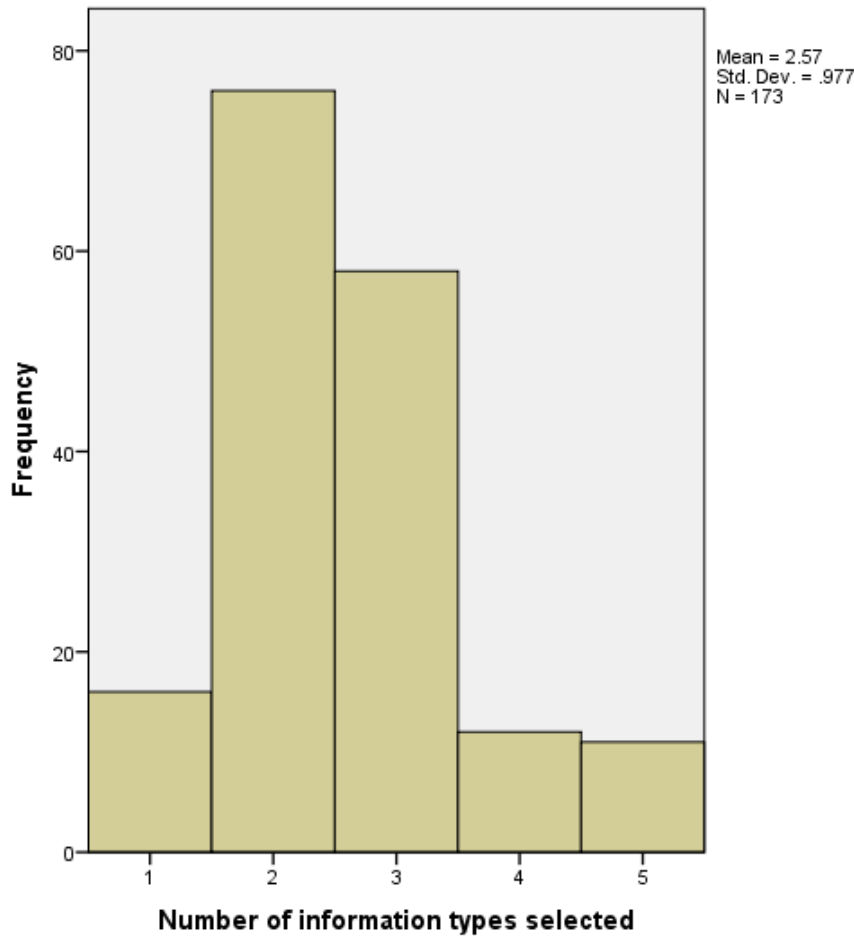
Figure 6. Information selection diversity: histogram of total number of different information types represented.

4.7 Planning Participant Measures and Representative Variables

The independent variables of interest for this research are *community planners* (planners), *hazardous materials emergency responders* (HazMat responders), and *HMCFS participant diversity*. The three independent variables are described further in the following sections.

4.7.1 Community planners

Of key interest for this research is whether community planners have a positive effect on the selection of communicative information when they participate in HMCFS projects. Community planners, through education and practice, are familiar with collection and analysis of communicative information. In recent decades, planners have also been exposed to an advocated need for and importance of communicative information in planning in education, training, and practice.

The community planner participation variable is indicated by direct informant responses to the survey question about HMCFS project participation, including local planning agency/authority employees. The frequencies of community planner participation in the HMCFS are provided in Table 6.

Table 6. Frequencies of community planner participation in HMCFS.

Planner Participation	Frequency	Percent	Valid Percent	Cumulative Percent
No	147	80.3	80.3	80.3
Yes	36	19.7	19.7	100.0
Total	183	100.0	100.0	

4.7.2 HazMat responders

Also of interest to this research is how participation of HazMat emergency responders in HMCFS projects influences the selection of communicative information. The *HazMat responder participation* variable indicates whether HazMat responders participated in the HMCFS project. Its measure is based on direct survey informant

responses for two underlying measures, HazMat incident response team participation in the HMCFS and HazMat incident commander participation in the HMCFS. An affirmative response for either or both of these underlying measures results in an affirmative outcome for the measure of HazMat responder participation. Further information about the underlying measures, their conceptual relationship, and analysis of their empirical relationship using principal components analysis and reliability analysis is provided in Appendix E.4.

HazMat responders have specific and highly-specialized training for dealing with hazardous materials incidents. Traditionally, HazMat responders have been housed in or closely allied with fire departments or public safety agencies, or less often they are separate regional entities. These organizations share similar structures, rules, norms, and operating protocols. Emergency responders are also likely to have temperaments and organizational norms that inhibit their ability to engage in participatory planning dialogue with diverse community stakeholders. Frequencies of HazMat responder participation in the HMCFS are provided in Table 7 for whether or not HazMat responders participated in the HMCFS project.

Table 7. Frequencies of HazMat responder participation in HMCFS.

HazMat Responder Participation	Frequency	Percent	Valid Percent	Cumulative Percent
No	137	74.9	74.9	74.9
Yes	46	25.1	25.1	100.0
Total	183	100.0	100.0	

4.7.3 HMCFS participant diversity

In addition to participation of community planners and HazMat responders in the HMCFS, other types of HMCFS participants that were measured include municipal, county, and state employees (an ordinal variable, comprised of municipal employees, county employees, and state employees, as described in Appendix E.4), LEPC members, volunteers, local industry representatives, contractors (an ordinal variable, comprised of private, university, or government contractors), other responder-related professions, and other participants. Thus, there are a total of nine potential conceptually different HMCFS participant categories. Binary variables of all these participant groups (yes/no for their participation in the HMCFS) were summed to create a *HMCFS participant diversity* variable that will be used as an independent variable for assessing Hypothesis 3. The maximum number of different participant categories in the research sample was six. A histogram of the HMCFS participation diversity variable is shown in Figure 7.
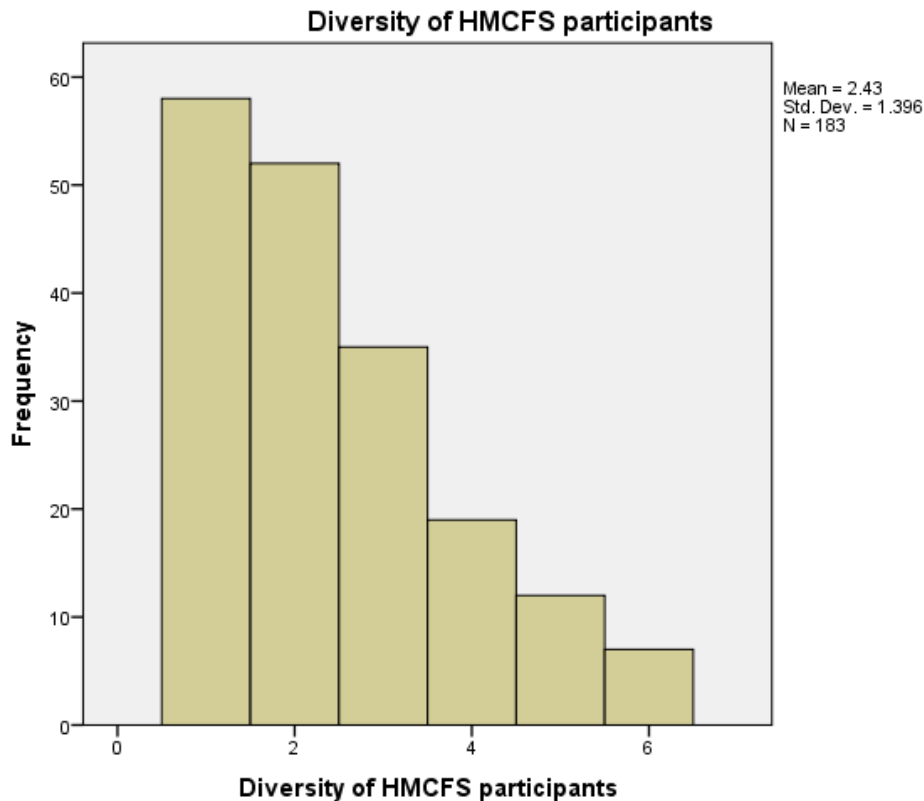
Figure 7. Histogram of HMCFS participant diversity variable.

4.8 Contextual Measures and Representative Variables

4.8.1 Selection of contextual variables

For the organizational context and the community context, a large number of variables were available from the survey data and other secondary sources that correspond to relevant measures. Appendix F, Table F.1 lists variables that were available for analysis, the form of variables (binary, ordinal, interval, and ratio) and sources of data, and the assigned associations of variables with different measures. While most variables listed in Appendix F are assigned associations with only one measure, some variables are assigned associations with two or three measures. For

example, a binary variable taken directly from LEPC survey responses is whether an

LEPC has ever asked another LEPC for a copy of its HMCFS. This variable is

interpreted as indicating both the LEPC's *knowledge* about HMCFS projects (presuming

they received and reviewed the requested HMCFS information) and the LEPC's use of

boundary spanning mechanisms (presuming that organizational boundaries were crossed

in making the request). Thus, this variable is *potentially* available for inclusion in the

analysis as an indicator of organizational knowledge and organizational boundary

spanning. The approach for selecting variables for inclusion in the analysis is described

below.

Given the large number of variables available to represent different theoretical

measures, a subset of these variables was selected that are representative of the

measures. For three measures (location, structure, and innovation), there are only one or

two associated questions in the survey with single-responses or dummy-coded variables

from which to choose. Selection of representative variables was straightforward for

these measures (described in their respective sections below), as there were limited

variables to choose from.

Remaining measures of the community and organizational context have a wide

range of associated and potentially representative variables. For example, among twelve

different remaining measures of community and organizational context, between 5 and

19 variables were available to represent different measures, with an average of 11

variables per measure. Combining variables into indexes was generally impractical for

analysis using this data set due to loss of cases and variation in variable types, ranges,

and distributions. To simplify representation of the contextual measures from the large number of available variables, and yet ensure that various theoretical constructs associated with different measures were represented, a selection process was utilized using principal component analysis. The two primary components among the set of variables associated with each measure (as categorized in Table F.1) were identified. Then, the two variables with the highest loading on each of the two primary components were identified. From these two variables, one variable for each component was selected based on its conceptual relationship with planning information, theories of communicative rationality, and LEPC stakeholders and practices.

The primary advantage of this approach is that it is consistent with a simplified empirical approach that results in a parsimonious solution, while ensuring that the important theoretical concepts are afforded the opportunity to play a role in the final analyses and statistical models. The utilization of specific variables enhances the ability to explain effects of specific variables on information selection. The resulting concrete empirical measures are readily-interpretable outcomes for policy recommendations and action by policy makers. However, this approach also limits the ability to represent the conceptual measures as completely as could potentially be accomplished using a greater number of contextual variables (and a greater number of cases as well), or construction of representative indices. Future investigations might include a greater number of contextual variables or construction of indices to represent important theoretical constructs, and compare those outcomes with results of this study.

Further discussion of the selected variables associated with each contextual and validity measure is provided in Sections 4.8.2 and 4.8.3 below.

4.8.2 Community and regional measures and representative variables

4.8.2.1 Attitudes and behaviors

The two variables that are selected to represent the community attitudes and behaviors measure are the *level of agreement that conducting HMCFS has been supported by local politicians* and the *absolute difference between the percent of county that voted Republican and Democrat for U.S. President in 2008*. Political support for planning efforts is also considered to be an important contributor to planning success, and emergency planning is of low priority for some local politicians. Local political attitudes and amount of political agreement can have an effect on attitudes of community planners, and also affect local perceptions about the importance of hazards and risks. Further information about selection of these variables from the eight potential variables of community attitudes and behavior is provided in Appendix G.1.

4.8.2.2 Economic basis

The two variables that are selected to represent the economic basis measure are *banking and insurance sector is a major area employer* and *mining and raw materials is a major area employer*. Banking and insurance, although not directly related to HazMat transportation, is strongly related to services-based industries, which represents nearly a quarter of the variance among variables explained by this primary component. Mining and raw materials are natural resources industries that can have contentious environmental planning activities, and also can be associated with transportation of

hazardous materials. Further information about selection of these variables from the 14 potential variables of community economic basis is provided in Appendix G.2.

4.8.2.3 Hazard and risk

The two variables that are selected to represent the hazard and risk measure are *jurisdiction is a significant HazMat origin* and *level of perceived HazMat transport incident risk for roads*. That a jurisdiction is a significant HazMat origin implies that local planners and emergency responders have knowledge of local HazMat producers by virtue of their interactions with facilities and local industrial sector personnel. Roads are a ubiquitous transport mode and can have minimal to extensive associated risks for HazMat transport, depending on traffic characteristics. Further information about selection of these variables from the eight potential variables of community hazard and risk is provided in Appendix G.3.

4.8.2.4 Location

The two variables that are selected to represent the location measure are *jurisdiction is located in the Midwest U.S.* and *jurisdiction is located in Texas*. Previous research by Starik, et al., (2000) indicates that LEPCs in the Midwest tend to be more proactive than their counterparts. Texas is among the states with the greatest number of LEPCs, a high concentration of HazMat facilities and transport activities, and is one of the states with the highest overall level of federal grant funding for hazardous materials emergency preparedness grants for training and planning.   Texas is also the state from which the request for participation was sent to potential survey informants, creating a possible validity threat due to reactivity biases.

4.8.2.5 Socio-economic demographics

The two variables that are selected to represent the socio-economic demographics measure are the natural log transformation of the *jurisdiction population* and the *percentage of population that is White*, both from U.S. Census data. Where Census data were not available, informant estimates of jurisdiction population were used. Increasing populations provide not only a greater resource base, but also greater challenges for community and emergency planning, including for transportation. Persistent poverty affects not only the resource base of the community, but also local attitudes and perceptions about planning and other community problems. Further information about selection of these variables from the eighteen potential variables of socio-economic demographics is provided in Appendix G.4.

4.8.3 LEPC organization measures and representative variables

4.8.3.1 Activity

The two variables that are selected to represent the organization activity measure are *frequency of LEPC formal meetings* and the *number of years in which the LEPC conducted HMCFS*. The level of activity of an organization, as indicated by its frequency of meeting, may affect the types of personnel that are involved, and the way that organization engages in planning projects. In addition, the number of planning projects that the organization engages in over time is not only an indicator of a culture or pattern of activity, but also provides both a baseline of information and knowledge and experience about how better to conduct the project. Further information about selection

of these variables from the five potential variables of organization activity is provided in Appendix G.5.

4.8.3.2 Boundary spanning

The two variables that are selected to represent the organization boundary spanning measure are that the *LEPC has ever asked another LEPC for a copy of its HMCFS* and that *communities/regional planning agencies requested the HMCFS* was a motivating factor for conducting the study. As organizations engage other organizations about how they conduct planning projects, not only do they possibly obtain additional information and data that may be relevant to their jurisdiction, they also learn about alternate perspectives and ways of doing things. This vicarious experience can in turn affect who is involved in planning projects and the information sources that are used. When an organization is engaged from its internal constituencies or other locally-affiliated agencies that request planning information, it is potentially exposed to different perspectives about community needs and expectations that may affect how the organization engages in those planning projects. Further information about selection of these variables from the fifteen potential variables of organization boundary spanning is provided in Appendix G.6.

4.8.3.3 Funding

The two variables that are selected to represent the organization funding measure are the natural log transformation of the *2007 total LEPC funding per thousand population* and the natural log transformation of the *amount of non-local funding received for the most-recent HMCFS per thousand population.* Not only does

organizational funding provide means of engaging in planning and other activities, but it also helps the organization promote involvement of its participants. Non-local funding, such as through grants, is a primary means by which LEPCs are able to conduct HMCFS projects, since most LEPCs are all-volunteer and have low levels of sustained resources. LEPC effectiveness in obtaining non-local funding for HMCFS projects may affect who is involved in the project, the amount of effort that goes into the project, and the types of information that are able to be obtained. Further information about selection of these variables from the ten potential variables of organization funding is provided in Appendix G.7.

4.8.3.4 Knowledge and experience

The two variables that are selected to represent the organization knowledge and experience measure are that *other HMCFS examples were used to guide how the HMCFS was conducted* and that *contractor knowledge/experience with the process was used to guide how the HMCFS was conducted.* Other project examples can function not only as guidance mechanisms to how planning projects can be conducted, but they can also function as sources of data or channels to other sources of data that the organization might not otherwise consider. If a contractor is utilized to assist the organization with conducting planning projects, the knowledge and experience of that contractor has implications for who is involved in the planning projects, the means by which the project is accomplished, and information sources that are utilized. Further information about selection of these variables from the nineteen potential variables of organization knowledge and experience is provided in Appendix G.8.

4.8.3.5 Membership

The two variables that are selected to represent the organization membership measure are that *transport carriers participate in the LEPC* and that *'Other' group representatives participate in the LEPC.* Although transport carriers are not among the entities that are most commonly represented in LEPCs, they are important LEPC stakeholders, since transport carriers are responsible for safe movement of hazardous materials through communities by transport routes. Survey informants had the option of indicating that 'other' group representatives participate in the LEPC, in addition to specifically identified groups. Examination of text responses associated with this response option did not identify a consistent subgrouping. This variable is thus interpreted as indicating participation of groups that do not typically participate in most LEPC organizations. Further information about selection of these variables from the fifteen potential variables of organization membership is provided in Appendix G.9.

4.8.3.6 Motives

The two variables that are selected to represent the organization motives measure are that *the LEPC thought the HMCFS was a good way to get a handle on HazMat flows in the community* and that *the SERC suggested the LEPC conduct the HMCFS.* The first of these variables suggests a motivation internal to the LEPC organization, while the second of these variables suggests an external motivation. Further information about selection of these variables from the fifteen potential variables of organization membership is provided in Appendix G.10.

4.8.3.7 Openness

The idea of openness relates to organizational receptiveness or capacity for new ideas or innovations. One variable of organizational openness is used in this research, whether the *LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials.* Such mechanisms or functions might provide indications about organizational willingness and responses to new inputs, such as diverse planning participants and information sources.

4.8.3.8 Resource access

The two variables that are selected to represent the organization's access to resources are that *local community staff time was available* for participating in the HMCFS and that *budget to hire a contractor was unavailable* for their participation in the HMCFS. Since LEPCs are primarily volunteer-based organizations, and many LEPCs use time from members and other participants as 'in-kind' matching funds for federal grants, local community staff time availability represents a potentially important organizational resources, as well as demonstrating local interest and commitment to the project. The lack of budget availability for hiring contractors also represents a resource limitation. For LEPC participants that are constrained by time requirements of their professional and personal responsibilities, the lack of budget for hiring a contractor might substantially affect the type of information that can be collected for HMCFS projects. Further information about selection of these variables from the nine potential variables of organization resource access is provided in Appendix G.11.

4.8.3.9 Structure

The two variables that are selected to represent the organization structure measure are *LEPC is a partly or totally regional jurisdiction* and *LEPC members or associates conducted HMCFS project*. Compared with primarily municipal and county-level LEPCs, a regional LEPC will typically include a greater number of jurisdictions (multiple municipalities/counties) and broader area. This in turn can affect how the LEPC works across administrative boundaries. That LEPC members or associates conducted the HMCFS project generally provides a greater level of involvement of the LEPC organization in the HMCFS than if another entity such as a federal agency, contractor, or other entity conducted the project. This in turn may affect specific aspects of the project, such as who participated, or which types of information were selected.

4.9 Bias Control Variables and Representative Variables

A number of variables were available from survey response data that allowed for investigation of whether personal characteristics of LEPC informants or survey administration may have influenced or otherwise biased survey responses. Principal component analysis was also used to select representative variables for measures of effects due to survey informants or survey administration.

4.9.1 Survey informants

The two variables that are selected to represent the survey informant measure are that the *informant is LEPC Chair, Director, Administrator, Coordinator, etc.* and the *informant has emergency management, emergency services, or public safety related occupation*. The survey informant measure is included to account for informants'

personal characteristics, such as their role in the LEPC organization or profession, which might bias their survey responses. Having a leadership role in the LEPC not only can indicate the level of knowledge that the informant has about the functioning of their organization, but it also can affect the impression that the informant tries to impart about their organization in survey responses. LEPCs are also organizations that are typically oriented to facilitate planning for chemical emergency response and management, and Section 2.3.2 describes the organizational perspectives of emergency responders which also apply to other paramilitary professions including emergency management and public safety. Further information about selection of these variables from the 13 potential variables of survey informant characteristics is provided in Appendix G.12.

4.9.2 Survey administration

The two variables that are selected to represent the survey administration measure are that the *survey instrument was distributed by the SERC* and the *number of years since the most-recent HMCFS was conducted*. The survey administration measure is included to account for reactivity to the experimental situation. The role of the SERC in distributing the survey participation request to LEPCs in six of the states provides a different context and implicit type of request than does distribution of the survey participation request by the researchers to the LEPCs, which may have affected the patterns of their responses in some way. The number of years since the most-recent HMCFS was conducted (which is the study that survey informants are providing information for) addresses possible maturation effects and/or memory impacts of

individual informants. Further information about selection of these variables from the

six potential variables of survey administration is provided in Appendix G.13.

4.10 Summary of Measures and Variables

The measures and variables that are used for the analysis are listed in Table 8.

Included in the table are the measure names, variable names, variable type, variable

range, mean, and number of cases. A correlation analysis for these variables is included

in Appendix J.

Table 8. Measures and selected variables for empirical analysis.

Measure Set	Measure	Variable	N	Type	Range	Mean	Std. Dev.
Information Selection	Communicative info. selection	Communicative information selection	183	Ordinal	0-3	0.74	.906
		Communicative information selection	183	Binary	0,1	.49	.501
	Info. selection diversity	Number of selected HMCFS info sources	173	Ratio	1-12	3.96	2.109
		Number of selected HMCFS info types	173	Ratio	1-5	2.57	.977
Planning Participants	Community planners	Local planning agency/authority employees participated in HMCFS	183	Binary	0,1	.20	.399
	HazMat responders	HazMat responders participated in HMCFS	183	Binary	0,1	.25	.435
	Diversity	HMCFS participant diversity	183	Ratio	1-6	2.43	1.396
LEPC Organization	Activity	Frequency of formal LEPC meetings (times/year)	183	Ratio	0–30	6.72	5.277
		Number of years in which LEPC has conducted HMCFS	183	Ratio	1–11	1.80	1.727
	Boundary spanning	LEPC has ever asked another LEPC for a copy of their HMCFS	172	Binary	0,1	.30	.458
		Primary reason for CFS: Communities/regional planning agencies requested it	183	Binary	0,1	.14	.350
	Funding	Total LEPC budget in 2007, per thousand population	97	Ratio	$0–$1,530	$131.70	$227.01
		Amount of non-local funding obtained for most-recent HMCFS, per thousand population	138	Ratio	$0–$2,253	$42.51	$220.55
	Knowledge & experience	Other HMCFS examples were used to guide HMCFS	180	Binary	0,1	.27	.443
		Contractor knowledge/experience with process was used to guide HMCFS	180	Binary	0,1	.26	.440
	Membership	Transportation carriers participate in LEPC	164	Binary	0,1	.35	.478
		'Other' group reps. participate in LEPC	164	Binary	0,1	.18	.388
	Motives	Primary reason for CFS: The HMCFS seemed a good way to get a handle on hazmat flows	183	Binary	0,1	.49	.501
		Primary reason for CFS: SERC suggested LEPC conduct a CFS	183	Binary	0,1	.15	.361

Table 8 continued. Measures and selected variables for empirical analysis.

Measure Set	Measure	Variable	N	Type	Range	Mean	Std. Dev.
	Openness	LEPC has mechanisms or specific functions for evaluating new ideas about HazMat.	165	Binary	0,1	.36	.483
	Resources	Local community staff time was available to conduct the HMCFS	179	Binary	0,1	.31	.465
		Budget to hire contractor to be involved in conducting the HMCFS was not available	179	Binary	0,1	.27	.444
	Structure	LEPC is regional jurisdiction	180	Binary	0,1	.07	.260
		LEPC members / associates conducted HMCFS	181	Binary	0,1	.56	.498
Community & Region	Attitudes & behaviors	Absolute value of difference between percent of jurisdiction that voted Republican and voted Democrat for U.S. President in 2008	177	Ratio	0–79	23.84	16.429
		Level of agreement that conducting HMCFS has had support of local politicians	165	Ordinal	1–5	3.52	0.801
	Economic basis	Banking and insurance sector is major area employer	164	Binary	0,1	.53	.501
		Mining or raw materials sector is major area employer	164	Binary	0,1	.19	.393
	Hazards & risks	Jurisdiction is significant HazMat origin	180	Binary	0,1	.27	.446
		Level of perceived hazmat transport incident risk for roads	182	Ordinal	2–10	7.87	1.846
	Location	LEPC region is in Midwest U.S.	183	Binary	0,1	.27	.447
		LEPC is in Texas	183	Binary	0,1	.09	.283
	Socio-economic demographics	Jurisdiction population	183	Ratio	2,058–14,218,613	241,281	1,087,677
		Percent of population that is White	178	Ratio	.23-.99	.85	.146
Informants & Survey Admin.	Informants	Informant is LEPC Chair, Director, Administrator, Coordinator, etc.	176	Binary	0,1	.58	.495
		Informant has emergency management, emergency services, or public safety related occupation	173	Binary	0,1	.61	.489
	Survey administration	Survey instrument was distributed by SERC	183	Binary	0,1	.08	.275
		Number of years since most-recent HMCFS was conducted	183	Ratio	0-10	3.80	3.180

4.12 Empirical Model

The empirical model for this research, shown in Figure 8, builds on the conceptual model described in Sections 3.1.
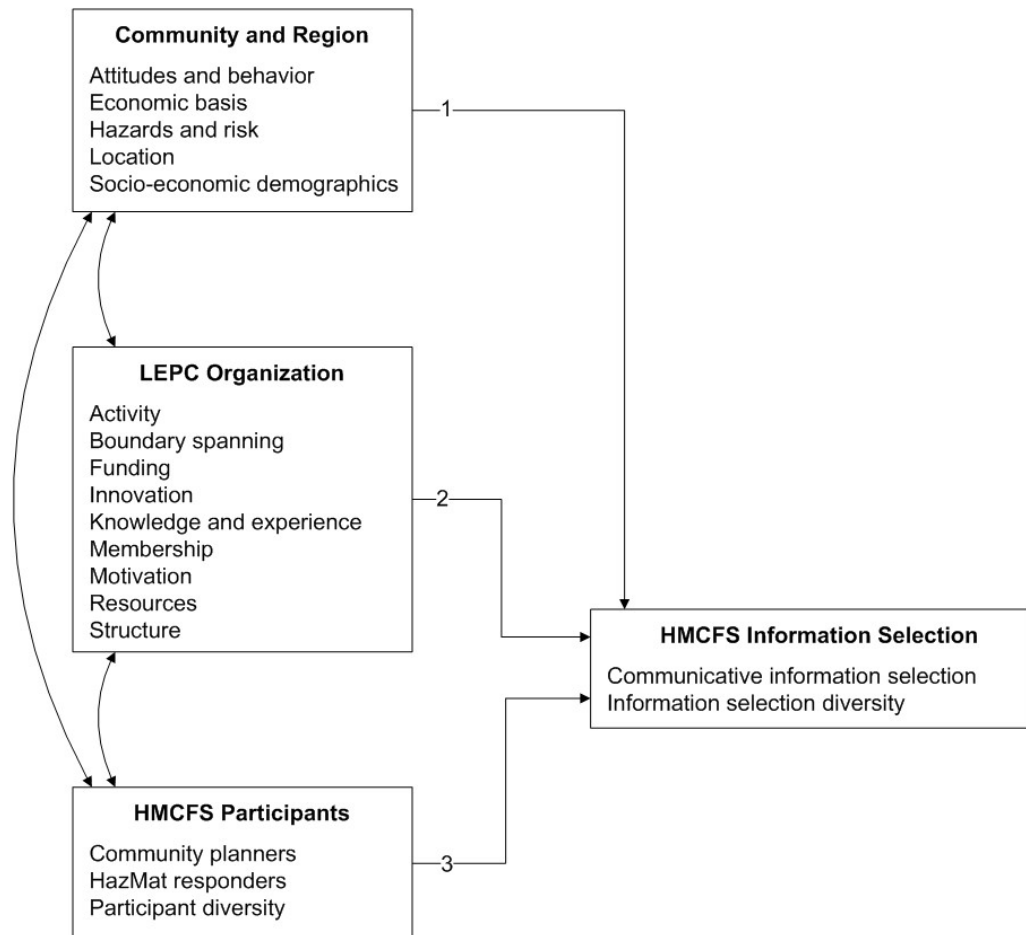
Figure 8. Empirical model.

Together, sets of measures and variables associated with the community and region, LEPC organization, and HMCFS participants form a hierarchical order as described by Cohen, Cohen, West, & Aiken (2003), hereafter referred to as a

'sequential' order, that reflects a posited causal priority from most-distal to most-proximal to the dependent variables of this study which are associated with HMCFS information selection. The ordering of these sets of measures and variables is the author's interpretation of their relationships, based on theory, literature, and practical experience. Of course, these measures and variables were measured cross-sectionally using a single survey instrument in 2008, so it is not possible to formally test the sequential ordering of these relationships.

The empirical model can be interpreted as follows: The first step in the sequential ordering considers the effects of variables that represent the community and region measures on the dependent variable under consideration, as indicated by the solid line labeled '1' in Figure 8. The next step in the sequential ordering considers the effects of variables that represent the LEPC organization measures on the dependent variable, as indicated by the solid line labeled '2' in Figure 8, while retaining statistically significant community and regional variables from the first step, as indicated by the curved line between the boxes with the headings 'community and region' and 'LEPC organization'. And so-on until effects of all sets of measures—community and region, LEPC organization, planning participants—are examined for their relationships with the dependent variable under consideration, while retaining more-distal variables which have statistical significance.

4.13 Regression Approach

Multiple linear regression (MLR) is utilized for analysis of regression models in which the form of the dependent variable is interval or ordinal. Binomial logistic

regression is used for analysis of regression models in which the form of the dependent variable is binary. Further information about these types of regression methods, including their forms and assumptions, are provided in Appendix H. Although multiple linear regression is not generally suggested for fewer than five categories in a dependent variable (P. D. Allison, 1999; DeMaris, 2005), it is used for this research as an initial assessment of relationships between the communicative information selection dependent variable and independent and contextual variables. Then, significant relationships are also assessed using logistic regression on the binary form of the communicative information selection dependent variable. In this way, although use of the multiple linear regression violates assumptions regarding the form of the dependent variable, the results can be compared against those obtained using a method that is appropriate to the dependent variable form, albeit with more-truncated binary forms of the dependent variables.

For Hypothesis 3, multiple linear regression is used to model empirical relationships between the HMCFS information selection diversity dependent variables (sources and types), the HMCFS participant diversity independent variable, and contextual variables.

4.13.1 Analytical approach for regression

Based on methods described by Allison (1999), Cohen, et al. (2003), and Garson (2006), the following approach is used for empirical assessment of variable relationships using multiple linear regression and binomial logistic regression.

A. Check relationships between variables to identify departures from linearity and address departures if necessary and appropriate through variable transformation or re-specification.

B. Check for multicollinearity (use VIF).

C. Enter variables into main effects predictive models.

D. Run model iterations using blocks of variable sets in sequential order (as described by Cohen, et al., 2003 for hierarchical ordering). A stepwise analysis procedure is used that provides a conservative approach by retaining contextual variables with lower statistical significance ($p \leq .10$).

    1. For any set of contextual variables added to the regression model, all variables in the added set with a significance of $p \leq .10$ or less (two-tailed) are retained through the addition of subsequent sets, regardless of whether they become non-significant upon addition of subsequent sets of variables.

    2. Independent variables of interest (participants) to this research are retained in regression models regardless of significance.

    3. A set of consistent contextual variables that are consistent across dependent variables facilitate comparison of variable performance. For communicative information selection, contextual variables are consistent for ordinal communicative information selection and binary communicative information selection. For information selection

diversity, contextual variables are consistent for number of selected

information sources and number of selected information types.

4. Following the addition of the final set of variables associated with

each dependent variable, those from previously entered sets are

removed in a stepwise approach based on lack of statistical

significance, similarity of variables, and expected importance of

relationship with dependent variable, until a parsimonious model

(Agresti & Finlay, 1997) is obtained.

E. Examine model significance and check compliance with assumptions.

F. Note the parameter estimates and significance and effect size for each block

to identify whether variable behavior is consistent in across models.

Calculate standardized coefficients for binomial logistic regression models as

described in Appendix H.

4.14 Potential Threats to Validity

Validity threats refer to inherent biases that limit the ability of researcher to make

valid statistical inferences. This study uses secondary data from federal agencies and

from a survey that was not conducted with the specific intention of assessing HMCFS

participation and information selection, but was rather conducted to identify best

practices of LEPCs in conducting HMCFS. While the ability to affect some validity

threats is accordingly limited, it is important to evaluate what potential threats are, and

whether and how they can be addressed. A number of potential statistical, external, and

interval validity threats are considered for the research. Threats to validity are described

in Shadish, Cook, and Campbell (2002), and threats with particular applicability to this

research and the means by which they are addressed are described in Appendix I.

5. FACTORS AFFECTING PLANNING INFORMATION SELECTION

The findings of the study are identified using two types of analysis. First, linear regression models are used to evaluate effects of independent and control variables on ordinal or interval forms of dependent variables. Second, binomial logistic regression models are used to evaluate effects of independent and control variables on the binary forms of the communicative information selection dependent variable, as confirmation of linear regression model outcomes. Results of the linear and binomial logistic regression models are presented in this section.

5.1 Regression Analysis

5.1.1 Communicative information selection

Multiple linear regression is used to test whether community planner and HazMat responder participation in HMCFS projects affects the level of communicative information selection. When considered on an individual basis, the participation of local planning agency/authority employees has a significant positive effect on the level of CI selection (Table 9). Participation of HazMat responders does not have a significant negative effect on the level of CI selection. The single-variable model for participation of community planners explains approximately five percent of the total variance in the level of CI selection, and the single-variable model for participation of HazMat responders explains approximately two percent of the total variance in the level of CI selection.

Table 9. Coefficients for linear regression of planner and HazMat responder participation in HMCFS on communicative information selection (0-3 scale).

Variable[a]	b (Beta)	b (Beta)
Local planning agency/authority employees participated in HMCFS	0.534*** (0.235)	
HazMat responders participated in HMCFS		0.292 (0.140)
Intercept	0.633***	0.644***
R-square	.055	.020
Adjusted R-square	.050	.014
F model	10.574*	3.636†
N	183	183

† p ≤ .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001;
a. Results on variables are for one-tailed significance tests.

Table 10 tests Hypotheses 1 and Hypothesis 2, and lists regression coefficients and model outcomes for a sequential analysis of the level of CI selection, using the variables listed in Table 8. Of the variables associated community and regional set of measures, that mining and raw materials is a major area employer, the jurisdiction is a significant HazMat origin, and the LEPC is located in Texas have significant, positive effects on level of CI selection. The model that includes this set of variables explains approximately six percent of the variance in level of CI selection, adjusted for the number of variables in the model.

Table 10. Linear regression models for sequential analysis of communicative information selection (Hypotheses 1 & 2).

Measures and Variables[a]	b (Beta)	b (Beta)	b (Beta)	b (Beta)
Economic Basis: Mining or raw materials is major area employer	0.358* (.156)	0.470** (.209)	0.409* (.182)	0.457** (.203)
Hazards & risks: Jurisdiction is significant HazMat origin	0.268† (0.131)	0.351* (.177)	0.358* (.180)	0.331* (.167)
Location: LEPC is located in Texas	0.634* (.197)	0.477† (.149)	0.456† (.142)	0.437† (.136)
Boundary spanning: LEPC has ever asked another LEPC for a copy of its HMCFS		0.358* (.185)	0.369* (.191)	0.362* (.187)
Knowledge & experience: Contractor knowledge/experience with process was used to guide HMCFS		0.371* (.181)	0.317† (.155)	0.337* (.165)
Structure: LEPC is regional (municipal or county) jurisdiction		-0.527* (-.159)	-0.552* (-.166)	-0.542* (-.163)
Structure: LEPC members or associates conducted HMCFS		0.313* (.175)	0.266† (.149)	0.286† (.150)
Local planning agency/authority employees participated in HMCFS			0.391** (.180)	0.417** (.192)
HazMat responders participated in HMCFS			0.167 (.083)	
Intercept	0.550***	0.171	0.093	-0.131
R-square	.080	.182	.225	.219
Adjusted R-square	.063	.143	.176	.175
F model	4.573**	4.648***	4.637***	5.071***
F change		4.576**	3.942*	
N	161	154	154	154

† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

a. Results are for two-tailed significance tests, except for local planning agency/authority employees and HazMat responders participated in HMCFS, which are one-tailed significance tests.

The next step in the sequential analysis is to consider variables associated with the LEPC organization. That the LEPC has ever asked another LEPC for a copy of its HMCFS, the use of contractor knowledge/experience to guide the HMCFS process, and that LEPC members or associates conducted the HMCFS all have significant, positive effects on level of CI selection. That the LEPC is a regional jurisdiction has a significant negative effect on the level of CI selection. With the addition of this set of variables to the community and regional set of variables, the model explains approximately 14 percent of the variance in the level of CI selection, adjusted for number of variables in the model.

The next step in the sequential analysis is to consider independent variables of primary interest to this research—participation of community planners and HazMat responders in HMCFS projects. Participation of community planners has a statistically significant, positive effect on level of CI selection when accounting for and retaining the antecedent factors described above, while participation of HazMat responders does not have a statistically significant negative effect. With the addition of this set of variables to the community and regional and organizational sets of variables, the model explains around 18 percent of the variance in the level of CI selection, adjusted for number of variables in the model.

The right-hand column of Table 10 shows a reduced regression model for variables that predict of the level of CI selection, individually removing variables that do not retain statistical significance in the sequential regression approach. Contextual variables are excluded in a stepwise manner until all variables are statistically significant

at a level of p ≤ .10. In the reduced linear regression model, that HazMat responders participated in the HMCFS is the only variable that was removed from the most-specified model. The reduced model accounts for more than 17 percent of the variance in the level of CI selection, adjusted for numbers of variables in the model.

Survey informant and survey administration variables were also considered for potential bias effects. No survey informant or survey administration variables are significant predictors of level of CI selection.

The CI selection dependent variable is ordinal and has a limited scale (0-3), and use of multiple linear regression for this dependent variable results in minor violations of regression assumptions (normal distribution and homoscedasticity of regression residuals). With the moderate number of cases in the regression model (over 100), the lack of normality in regression residuals is less problematic and heteroscedasticity of regression residuals is the more concerning of these violations. Thus, the effects of community planner and HazMat responder participation in HMCFS projects on CI selection are tested using an alternate method to provide confirmation of linear regression outcomes. Binomial logistic regression is used to measure effects of independent and contextual variables on the binary form of the dependent variable, where a score of 1 is assigned if any communicative information source was selected, and a score of 0 is assigned if no communicative information sources were selected.

The results of the binomial logistic regression analysis on the binary form of the CI selection variable support those of the multiple linear regression analysis on the ordinal form of the CI selection dependent variable. When considered individually

(Table 11), participation of local planning agency/authority employees in HMCFS

projects has a statistically significant, positive effect on CI selection. Participation of

HazMat responders in HMCFS projects does not have a statistically significant negative

effect on CI selection.

Table 11. Coefficients for logistic regression of planner and hazmat responder
participation in HMCFS on communicative information selection (binary).

Variable[a]	B *Exp(B)*	B *Exp(B)*
Local planning agency/authority employees participated in HMCFS	0.925** *2.523*	
HazMat responders participated in HMCFS		0.542 *1.719*
Constant	-0.232 *0.793*	-0.190 *0.827*
-2 LL of model	247.644	251.058
Cox & Snell R-square	.032	.014
Nagelkerke R-square	.042	.018
N	183	183

† $p \leq .10$; ** $p \leq .01$
a. Results are for one-tailed significance tests.

Binomial logistic regression is also used to evaluate variables in a sequential

order, in a similar manner as is used for the multiple linear regression models. These

models are shown in Table 12, which also tests Hypotheses 1 and 2. Two variables that

are significant in the reduced linear regression model—that the LEPC is a regional

jurisdiction and that the LEPC jurisdiction is a significant HazMat origin (which was

retained in the reduced model to provide greater stability of model performance)—are

not significant in the reduced binomial logistic regression model. The direction of

relationships is consistent for all other significant variables. Predictive ability of binomial regression models can be measured using the increase in percentage of cases that are correctly predicted in specified regression models over base or unspecified regression models (Garson, 2011b). The variables that are included in the binomial logistic regression models increase their predictive ability from around 50-51 percent for unspecified models to around 66-68 percent for most-specified and reduced binomial logistic regression models.

The results of the multiple linear and binomial logistic regression models support *Hypothesis 1*: *The participation of community planners in planning projects will significantly increase the selection of communicative-oriented information.* Planner participation in HMCFS projects is a significant and positive predictor of CI selection for both ordinal and binary forms of the dependent variable, when considered individually and when other variables that are considered in these analyses are accounted for. Participation of community planners in HMCFS projects increases the level of CI selection by almost 0.4 units in the reduced linear regression model. Participation of community planners in HMCFS projects increases the odds that one or more communicative information sources will be selected by a factor of more than two.

Table 12. Logistic regression models for sequential analysis of communicative information selection (Hypotheses 1 & 2).

Measures and Variables[a]	B (b^*_M) Exp(B)	B (b^*_M) Exp(B)	B (b^*_M) Exp(B)	B (b^*_M) Exp(B)
Economic basis: Mining or raw materials is major area employer	1.175** (0.214) 3.239	1.671*** (0.279) 5.316	1.616** (0.259) 5.031	1.580* (0.257) 4.854
Hazards & risk: Jurisdiction is significant HazMat origin	0.535 (0.109) 1.707	0.649 (0.123) 1.914	0.659 (0.121) 1.932	0.496 (0.092) 1.642
Location: LEPC is located in Texas	1.225† (0.160) 3.403	1.077† (0.126) 2.936	1.108† (0.126) 3.028	1.226† (0.145) 3.409
Boundary spanning: LEPC has ever asked another LEPC for a copy of its HMCFS		0.659† (0.128) 1.933	0.695† (0.131) 2.003	0.646† (0.123) 1.907
Knowledge & experience: Contractor knowledge/experience with process was used to guide HMCFS		1.056* (0.194) 2.873	0.975* (0.173) 2.652	0.891† (0.161) 2.439
Structure: LEPC is regional (municipal or county) jurisdiction		-0.813 (-0.092) 0.444	-0.839 (-0.092) 0.432	
Structure: LEPC members or associates conducted HMCFS		1.140* (0.240) 3.126	1.049* (0.213) 2.854	1.042* (0.215) 2.835
Participants: Local planning agency/authority employees participated in HMCFS			0.828* (0.139) 2.290	0.829* (0.140) 2.292
Participants: HazMat responders participated in HMCFS			0.232 (0.042) 1.261	
Intercept	-0.497* 0.608	-1.638*** 0.194	-1.803*** 0.165	-1.695*** 0.184
-2 LL of model	209.316**	184.682***	180.618***	187.633***
Change in -2LL for block	209.316**	14.810**	4.064	
Fit (Hosmer & Lemeshow sig.)	.913	.772	.173	.439
Cox & Snell R-square	.082	.170	.192	.174
Nagelkerke R-square	.110	.228	.256	.232
N	161	154	154	157

† p ≤ .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001

a. Results are for two-tailed significance tests, except for local planning agency/authority employees and HazMat responders participated in HMCFS, which are one-tailed significance tests.

The results of the multiple linear and binomial logistic regression models do not support *Hypothesis 2: The participation of emergency responders in planning projects will significantly decrease the selection of communicative-oriented information.* Regression results do not provide evidence of a significant negative relationship when participation of HazMat responders in HMCFS projects is considered by itself or when causally precedent variables are included in linear and logistic regression models.

5.1.2 Information selection diversity

Multiple linear regression is used to test the effects of HMCFS participant diversity, measured using an ordinal scale between 1 and 6, on HMCFS information selection diversity, which is measured in terms of the number of selected HMCFS information sources and number of selected HMCFS information types. When considered on an individual basis, each unit increase in HMCFS participant diversity has a significant, positive effect on HMCFS information selection diversity for both sources and types of information, as listed in Table 13. These single-variable models explain around nine percent and five percent of the total variance in information selection diversity for sources and types, respectively.

Table 13. Coefficients for linear regression of diversity of HMCFS participants on information selection diversity.

| | Information Selection Diversity Variable | |
| | Sources | Types |
Variable[a]	b (Beta)	b (Beta)
Diversity of HMCFS participants	0.464***	.156**
(1-6 ordinal as ratio covariate)	(.310)	(.225)
Intercept	2.817***	2.188***
R-square	.096	.051
Adjusted R-square	.091	.045
F model	18.163***	9.102**
N	173	173

** $p \leq .01$; *** $p \leq .001$

a. Variable results are for a one-tailed significance test with a significance cutoff value of $p \leq .05$.

Tables 14 and 15 test Hypothesis 3, and list regression coefficients and model outcomes for a sequentially-ordered analysis of information selection diversity for information sources and information types, respectively. As listed in Table 14, that mining and raw materials is a major area employer and that the jurisdiction is a significant HazMat origin have significant, positive effects on the number of selected HMCFS information sources. The level of agreement that conducting HMCFS has support of local politicians is also significant ($p \leq .10$) in this model. The model that includes this set of variables explains approximately seven percent of the variance in the number of selected HMCFS information sources. As listed in Table 15, that the jurisdiction is a significant HazMat origin has a significant, positive effect on the number of selected HMCFS information types, but other variables are not statistically significant in the model that includes only the community and regional variables.

Table 14. Linear regression models for sequential analysis of information selection diversity—sources (Hypothesis 3).

Measures and Variables[a]	b (Beta)	b (Beta)	b (Beta)	b (Beta)	b (Beta)	b (Beta)	b (Beta)
Attitudes & behaviors: Level of agreement that conducting HMCFS has the support of local politicians	.377† (.141)	0.239 (.089)	0.177 (.069)	0.222 (.083)	0.181 (.070)		
Economic basis: Mining or raw materials is major area employer	1.198** (.219)	1.001* (.183)	0.962* (.181)	0.765† (.140)	0.657 (.124)	0.826* (.151)	
Hazards & risks: Jurisdiction is significant HazMat origin	.970* (.198)	0.923* (.187)	0.947* (.199)	0.954** (.193)	0.927* (.194)	0.960** (.198)	0.723* (.156)
Socio-economic demographics: Natural log of jurisdiction population	-.156 (-.112)	-0.153 (-.109)	-0.154 (-.105)	-0.157 (-.113)	-0.166 (-.112)		
Activity: Square root of number of years in which LEPC has conducted HMCFS		0.539† (.124)	0.816* (.164)	0.501 (.115)	0.754† (.151)	0.585† (.134)	0.916* (.186)
Boundary spanning: LEPC has ever asked another LEPC for a copy of its HMCFS		1.195** (.254)	0.957* (.207)	1.115** (.237)	0.928* (.201)	1.164** (.248)	0.746† (.163)
Knowledge & experience: Other HMCFS were used to guide HMCFS		1.030** (.212)	0.814† (.171)	0.949* (.195)	0.678 (.142)	0.816* (.168)	0.653† (.138)
Knowledge & experience: Contractor knowledge/experience with process was used to guide HMCFS		0.774* (.154)	0.927† (.175)	.655† (.131)	0.758† (.143)		
Openness: LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials		0.111 (.025)	-0.161 (-.037)	.101 (.023)	-0.195 (-.044)		
Resources: Participants were involved because budget to hire contractor to be involved in HMCFS was not available		0.706† (.142)	0.950* (.199)	0.582 (.117)	0.806* (.169)		
Funding: Natural log of amount of non-local funding for most-recent HMCFS per thousand population			0.239* (.204)		0.242* (.207)		0.279** (.238)
Participants: Diversity of HMCFS participants				0.251* (.158)	0.299* (.191)	0.312** (.201)	0.396*** (.265)
Intercept	3.978**	2.699†	2.473	2.403	2.124	1.583**	1.060†
R-square	.132	.322	.365	.343	.396	.302	.317
Adjusted R-square	.108	.273	.299	.291	.326	.273	.282
F model	5.605***	6.598***	5.496***	6.553***	5.670***	10.528***	9.070
F change	5.605***	6.587***	5.742***	4.460*	5.179*		
N	153	150	117	150	117	153	124

† p ≤ .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001

a. Results are for two-tailed significance tests, except for diversity of HMCFS participants, which are one-tailed significance tests.

Table 15. Linear regression models for sequential analysis of information selection diversity—types (Hypothesis 3).

Measures and Variables[a]	b (Beta)	b (Beta)	b (Beta)	b (Beta)	b (Beta)	b (Beta)	b (Beta)
Attitudes & behaviors: Level of agreement that conducting HMCFS has the support of local politicians	.083 (.067)	-0.007 (-.006)	-0.042 (-.036)	-0.013 (-.011)	-0.041 (-.035)		
Economic basis: Mining or raw materials is major area employer	0.309 (.122)	0.119 (.047)	0.125 (.051)	0.030 (.012)	0.009 (.004)		
Hazards & risks: Jurisdiction is significant HazMat origin	0.322† (.142)	0.311† (.136)	0.288 (.132)	0.323* (.141)	0.280 (.129)	0.293† (.132)	
Socio-economic demographics: Natural log of jurisdiction population	-0.086 (-.133)	-0.092† (-.142)	-0.126* (-.187)	-0.094† (-.145)	-0.130* (-.193)	-0.072† (-.113)	-0.090† (-.137)
Activity: Square root of number of years in which LEPC has conducted HMCFS		0.369** (.183)	0.556** (.244)	0.355* (.176)	0.533** (.234)	0.385** (.191)	0.585*** (.258)
Boundary spanning: LEPC has ever asked another LEPC for a copy of its HMCFS		0.768*** (.352)	0.649*** (.308)	0.738*** (.339)	0.639*** (.303)	0.701*** (.323)	0.590*** (.283)
Knowledge & experience: Other HMCFS were used to guide HMCFS		0.549** (.244)	0.476* (.218)	0.519** (.231)	0.427* (.195)	0.556*** (.248)	0.443** (.208)
Knowledge & experience: Contractor knowledge/experience with process was used to guide HMCFS		0.162 (.071)	0.259* (.107)	0.120 (.052)	0.195 (.080)		
Openness: LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials		0.244† (.118)	0.120 (.060)	0.240† (.116)	0.108 (.053)		
Resources: Participants were involved because budget to hire contractor to be involved in HMCFS was not available		0.140 (.061)	0.194 (.089)	0.093 (.041)	0.140 (.064)		
Funding: Natural log of amount of non-local funding for most-recent HMCFS per thousand population			0.080† (.150)		0.082† (.153)		0.091* (.169)
Participants: Diversity of HMCFS participants				0.094* (.128)	0.113* (0.158)	0.097* (.137)	0.116* (.169)
Intercept	3.127***	2.514***	2.734***	2.403***	2.602**	2.241***	2.152**
R-square	.055	.363	.384	.377	.405	.350	.370
Adjusted R-square	.029	.317	.320	.327	.336	.324	.339
F model	2.150†	7.919***	5.959***	7.588***	5.898***	13.554***	11.664***
F change		11.212***	8.006***	3.094†	3.602†		
N	153	150	117	150	117	158	126

† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

a. Results are for two-tailed significance tests, except for diversity of HMCFS participants, which are one-tailed significance tests.

The next step in the sequential analyses is to consider variables associated with the LEPC organization. For the number of selected HMCFS information sources (Table 14), the number of years in which an LEPC conducted HMCFS (using a square root transform to linearize the relationship of the variable with regression residuals), that the LEPC has ever asked another LEPC for a copy of its HMCFS, and the use of other HMCFS to guide how the LEPC's most-recent HMCFS was conducted have significant positive effects. Use of contractor knowledge/ experience to guide how the HMCFS was conducted, and that participants were involved in the HMCFS project because budget to hire a contractor was not available also have significant positive effects on the number of selected HMCFS information sources. That the LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials is not significant in this model, but is retained to provide for a consistent set of variables across models of the two information selection diversity measures. The community and regional variable for level of agreement that conducting HMCFS has had support of local politicians becomes not statistically significant in this and subsequent regression models. With the addition of the organizational of variables to the community and regional set of variables, the model explains approximately 27 percent of the variance in the number of selected HMCFS information sources, adjusted for the number of variables in the model.

In considering the number of selected HMCFS information types (Table 15), the square root transform of the number of years in which an LEPC conducted HMCFS, that the LEPC has ever asked another LEPC for a copy of its HMCFS, and the use of other HMCFS to guide how the LEPC's most-recent HMCFS project was conducted also have

significant, positive effects. That the LEPC has mechanisms or specific functions for

evaluating new ideas about hazardous materials is also a significant, positive predictor of

number of selected HMCFS information types in this model. Use of contractor

knowledge/ experience to guide how the HMCFS project was conducted, and that

participants were involved in the HMCFS project because budget to hire a contractor

was not available are not significant predictors of the number of selected HMCFS

information types, but are retained to provide a consistent set of variables across the two

information selection diversity measures. In addition, the community and regional

variable for jurisdiction population (using a natural log transform to linearize the

relationship of this variable with regression residuals) has a statistically significant

negative relationship with the dependent variable in this model. The model explains

approximately 31 percent of the variance in the number of HMCFS information types

that were selected, adjusting for number of variables in the model.

The natural log-based transformation of the amount of non-local funding

obtained by the LEPC for the HMCFS per thousand population of the jurisdiction is also

considered for each information selection diversity variable, albeit in separate analyses

because of the substantial number of cases that are lost upon including this variable. The

models that add this funding variable to other organization variables account for

approximately 30 and 32 percent of the variance in number of selected HMCFS

information sources and the number of selected HMCFS information types, respectively.

This suggests that increasing levels of project funding has a positive effect on

information selection diversity in HMCFS projects. However, although the directions of

the relationships for other variables in this model are consistent with models that do not include this funding variable, the significance of some other variables changes. Unfortunately, it is not clear whether the changes in significance are due to changes in the variance associated with the funding variable, the cases that are lost for the analysis, or both.

The next step in the sequential analysis is to consider the independent variable, HMCFS participant diversity. HMCFS participant diversity has a statistically significant, positive effect on information selection diversity when accounting for and retaining the above antecedent factors, both for number of selected HMCFS information sources and number of selected HMCFS information types. With the addition of the independent variable to the contextual community and regional variables and organizational variables, the model explains almost 30 percent of the variance in number of selected HMCFS information sources, and almost 33 percent of variance in the number of selected HMCFS information types. Again, separate models include the project funding variable, and with this variable included, HMCFS participant diversity retains the direction and significance of its relationship with measures of HMCFS information selection diversity.

The two right-hand columns in Tables 14 and 15 show reduced regression models for number of selected HMCFS information sources and number of selected HMCFS information types, but individually removing other variables that do not retain statistical significance in the sequential regression approach. Contextual variables are excluded in a stepwise manner until all variables are statistically significant at a level of

p ≤ .10. The second-from-right-hand models in Tables 14 and 15 do not include the

project funding variable, while the most-right-hand models in these tables do include the

funding variable. In these reduced models, HMCFS participant diversity has significant

positive effects on information selection diversity for both number of selected HMCFS

information sources and number of selected HMCFS information types. Organizational

variables including the square root transformation of the number of years in which an

LEPC has conducted HMCFS, that the LEPC has ever asked another LEPC for a copy of

its HMCFS, and that other HMCFS were used to guide how the LEPC's most-recent

HMCFS was conducted are significant, positive predictors of information selection

diversity for both measures. The natural log-based transformation of amount of non-

local funding for the LEPC's most-recent HMCFS per thousand population is significant

for both information selection diversity variables as well.

In the reduced models, significance of community and regional variables is less

consistent across the different information selection diversity variables. That mining and

raw materials is a major area employer and that the jurisdiction is a significant HazMat

origin are both significant at p ≤ .05 or less in the reduced model predicting the number

of selected HMCFS information sources without funding included, but only the latter

contextual variable retains statistical significance when funding is included. That the

jurisdiction is a significant HazMat origin and the natural log of the jurisdiction

population are both significant at p ≤ .10 in the reduced model predicting number of

selected HMCFS information types without funding included, but only the latter retains

statistical significance when funding is included (this variable has a negative coefficient).

The reduced regression models explain around 27 to 28 percent of the variance in number of selected HMCFS information sources, and around 32 to 34 percent of the variance in number of selected HMCFS information types.

Finally, survey informant and survey administration variables are considered for potential bias effects. For the reduced model predicting the number of selected HMCFS information sources which does not include the funding variable, that the informant is LEPC Chair, Director, Administrator, Coordinator, etc. has a positive coefficient (0.561) and is statistically significant ($p \leq .10$). Also that the survey request for participation was distributed by SERC has a negative coefficient (-1.183) and is statistically significant ($p \leq .05$). No other coefficients of variables included in reduced models in Table 14 change direction of relationship or become statistically not significant with inclusion of survey informant or survey administration variables. Total explained variance in the dependent variable for this model is .340.

In the reduced model predicting the number of selected HMCFS information sources which does include the funding variable, only that the survey request for participation was distributed by SERC is significant ($p \leq .05$) with a negative coefficient (-1.340). In this model, the contextual organizational variable that other HMCFS were used to guide how the most-recent HMCFS was conducted is not significant, although direction of the relationship of this variable with the dependent variable does not change. Total explained variance in the dependent variable for this model is .355. For the

reduced model predicting the number of selected HMCFS information types that includes the funding variable, no survey informant or survey administration variables are statistically significant.

The results of the regression analysis support *Hypothesis 3: An increase in the diversity of participants in planning projects will significantly increase the diversity of selected information.* HMCFS participant diversity is a positive, statistically significant predictor of both of the HMCFS information selection diversity variables when considered by itself, and when community and organizational contextual variables are accounted for. A unit increase in HMCFS participant diversity corresponds to approximately a 0.3 unit increase in number of selected HMCFS information sources, and around a 0.1 unit increase in the number of selected HMCFS information types. For example, an LEPC that increases the number of different types of HMCFS participants from one to six would, on average, be expected to select around two additional HMCFS information sources, or one-half additional HMCFS information types.

5.2 Summary of Findings

5.2.1 Communicative information selection

Table 16 summarizes the direction and importance of relationships between independent and contextual variables and binary and ordinal measures of HMCFS communicative information selection. The direction of relationships is based on the direction (positive or negative) of relationships between independent or contextual variables and dependent variable. The average rank importance is given by the average rank of beta coefficients for each independent or contextual variable, relative to other

variables across the most-specified and reduced regression models. If a variable is not retained in reduced regression models, the average rank importance is based only on its beta coefficient rank in the most-specified regression models in Tables 10 and 12 for ordinal and binary communicative information selection variables, respectively. The relative importance for each variable in Table 16 is based its importance across regression models for binary and ordinal measures of HMCFS communicative information selection. A greater emphasis is given on outcomes for the binary CI variable in assigning relative importance. This is because analysis of the binary variable using binomial logistics regression is appropriate for the form of that dependent variable, whereas the analysis of the ordinal variable using multiple linear regression results in minor violations of the statistical tests.

The most important variable for predicting communicative information selection is that mining or raw materials is a major area employer. Variables of medium importance for predicting communicative information selection are that the LEPC has ever asked another LEPC for a copy of its HMCFS, that contractor knowledge/ experience with the HMCFS process was used to guide how the HMCFS was conducted, that LEPC members or associates conducted the HMCFS, and that local planning agency/authority employees participated in the HMCFS.

Table 16. Summary of communicative information selection outcomes.

| Measure & Variable | Communicative Information Selection | | | | |
| | Direction of Relationship | | Average Rank Importance | | |
	Binary CI Variable	Ordinal CI Variable	Binary CI Variable	Ordinal CI Variable	Relative Importance
Economic basis: Mining or raw materials is major area employer	+	+	1.0	1.5	High
Hazards & risk: Jurisdiction is significant HazMat origin	NS	+	NS	3.5	Low
Location: LEPC is located in Texas	+	+	5.0	8.0	Low
Boundary spanning: LEPC has ever asked another LEPC for a copy of its HMCFS	+	+	5.5	2.0	Med.
Knowledge & experience: Contractor knowledge/ experience with process was used to guide HMCFS	+	+	3.0	5.5	Med.
Structure: LEPC is regional (municipal or county) jurisdiction	NS	–	NS	5.5	Low
Structure: LEPC members or associates conducted HMCFS	+	+	2.0	7.0	Med.
Participants: Local planning agency/authority employees participated in HMCFS	+	+	4.5	3.0	Med.
Participants: HazMat responders participated in HMCFS (ordinal)	NS	NS	NS	NS	NS

Direction and importance of relationship: + = positive, - = negative, NS = not significant, Med. = medium.

That the jurisdiction is a significant HazMat origin, that the LEPC is located in Texas, and that the LEPC is a regional jurisdiction are of lower relative importance in communicative information selection compared with other variables in regression models. (The variables which indicate that the jurisdiction is a significant HazMat origin and that the LEPC is a regional jurisdiction are not significant in binary logistic regression models, but of medium importance in multiple linear regression models.) Finally, that HazMat responders participated in the HMCFS is not significant in regression models for either measure of communicative information selection.

5.2.2 Information selection diversity

Table 17 summarizes the direction and importance of relationships between independent and contextual variables and measures of HMCFS information selection diversity—the number of selected HMCFS information sources and the number of selected HMCFS information types. As with communicative information selection, the direction of relationship for each independent or contextual variable is based on its direction of relationship with dependent variables, the average rank importance is given by the average rank of beta coefficients for the variable, relative to other variables in the most-specified and reduced regression models, including models with and without the HMCFS funding variable. If a variable is not retained in reduced regression models, the average rank importance is based only on its average beta coefficient ranks in the most-specified regression models.

Table 17. Summary of information selection diversity outcomes.

| Measure & Variable | Information Selection Diversity | | | | |
| | Direction of Relationship | | Average Rank Importance | | Relative Importance |
	Sources	Types	Sources	Types	
Attitudes & behaviors: Level of agreement that conducting HMCFS has the support of local politicians	NS	NS	NS	NS	NS
Economic basis: Mining or raw materials is major area employer	+?	NS	6.0	NS	Low
Hazards & risks: Jurisdiction is significant HazMat origin	+	+?	3.5	5.7	Med.
Socio-economic demographics: Natural log of jurisdiction population	NS	–?	NS	5.0	NS
Activity: Square root of number of years in which LEPC has conducted HMCFS	+?	+	5.5	2.5	Med.
Boundary spanning: LEPC has ever asked another LEPC for a copy of its HMCFS	+	+	2.0	1.0	High
Knowledge & experience: Other HMCFS were used to guide HMCFS	+?	+	5.0	2.5	Med.
Knowledge & experience: Contractor knowledge/experience with process was used to guide HMCFS	+	NS	6.5	NS	Low
Openness: LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials	NS	+?	NS	7.0	NS
Resources: Participants were involved because budget to hire contractor to be involved in HMCFS was not available	+?	NS	6.0	NS	Low
Funding: Natural log of amount of non-local funding for most-recent HMCFS per thousand population	+	+	1.5	5.0	High
Participants: Diversity of HMCFS participants	+	+	2.8	5.0	Med.

Direction and importance of relationship: + = positive, - = negative, NS = not significant, ? = lack of consistently significant relationships in regression models, Med. = medium.

The relative importance for each variable in Table 17 is based its importance across regression models for measures of HMCFS information selection diversity. A greater emphasis in assigning relative importance is given on outcomes for the number of selected information sources. This is because the number of selected information sources is indicated by a broader range (values between 1 and 12) and more suitable for analysis using multiple linear regression compared with the number of selected information types, which is indicated by a more narrow range (values between 1 and 5).

The most important variable for predicting measures of information selection diversity is that the LEPC has ever asked another LEPC for a copy of its HMCFS. The amount of HMCFS funding is also of high importance, although it is more important for number of selected information sources than for number of selected information types. That the jurisdiction is a significant HazMat origin, LEPC experience with HMCFS projects (indicated by the square root transformation of number of years in which HMCFS projects were conducted), that other HMCFS were used to guide the LEPC's most-recent HMCFS, and diversity of HMCFS participants are of medium relative importance compared with other variables in the regression models. That mining or raw materials is a major area employer, that contractor knowledge/experience with the HMCFS process was used to guide how the HMCFS was conducted, and that participants were involved in the HMCFS project because budget to hire a contractor was not available are of low relative importance compared with other variables in the regression models.

The level of agreement that conducting HMCFS has the support of local politicians, the jurisdiction's population, measured using its natural log transformation, and that the LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials are listed as having a 'not significant' relative importance. Two of these variables appear to have possible significant effects on the number of selected information types that were selected, but were not significant in models for number of selected information sources.

Section 6 discusses and interprets the selection of information in HMCFS projects and the factors that affect information selection for communicative-based information and for information selection diversity. Section 6 then follows the discussion of research results with further discussion about implications and recommendations for emergency planning, and for planning theory and practice.

6. DISCUSSION

6.1 Information Selection by Planning Participants

Section 6.1 discusses and interprets the selection of information in HMCFS projects and the factors that affect information selection for communicative-based information and for information selection diversity. The discussion focuses especially on the roles of participants in HMCFS projects and their effects on information selection. It augments these analyses with interpretations for contextual variables that were found to influence information selection. Section 6.2 follows with further discussion about implications and recommendations for emergency planning, and for planning theory and practice.

6.1.1 Communicative information selection

Overall, nearly half of the LEPCs in the sample reported selecting communicative-based information that was obtained via interviews with stakeholders who may be substantially impacted by local emergency planning activities—local emergency responders, industry representatives, and/or transportation carriers. These results suggest that obtaining subjective information via interviews with at least some key organizational stakeholders is considered to be an important part of the fact-basis for local emergency planning by many LEPCs. Because of the numerous constraints for public participation in emergency planning, many practical limitations hinder collection of subjective information from a broad range of potential community stakeholders. Although free-form responses did not identify use of other communicative-based

information sources in HMCFS projects, further research is needed to identify the degree that these organizations seek communicative-based information from a broad range of emergency planning stakeholders.

In the setting of LEPCs and HMCFS, community planner participation in HMCFS projects has a significant positive effect on communicative information selection. This outcome supports Hypotheses 1: *The participation of community planners in planning projects will significantly increase the selection of communicative-oriented information.* When compared with other variables in regression models, community planner participation is of medium relative importance. The strength of this relationship suggests that the effect of variable might not be substantially attenuated if a greater number of contextual variables are included in the analysis, either directly or by proxy through use of indices. However, further research is needed to confirm this.

These results appear to be similar to those of previous research on the effects of community planner participation in planning projects. Burby (2003) reports a significant positive relationship between planning directors or staff being the source of planning initiatives in comprehensive planning processes and the number of proposed hazard mitigation variables. However, that effect was not significant for the success of implementing proposed variables, but rather community planner involvement for this outcome was posited as acting through other factors—strengths of comprehensive plans and the role of planners in "informing and empowering stakeholders through inclusive citizen involvement processes" (Burby, 2003, pp. 40-41).

Other studies point to the training, expertise, and values of planners in promoting

community participation in planning by bringing together and facilitating dialogue

among diverse stakeholders, and their "know how" in obtaining and interpreting

communicative information—i.e., their communicative rationality skills (Dalton, 2007;

Howe, 1980). Results from empirical studies suggest that planners are frequently

involved in both community interaction and data analysis (Dalton, 2007), that those in

planning professions and closely affiliated fields tend to rate communications skills as

more important than technical skills (Guzzetta & Bollens, 2003), and that belonging to

certain types of planning specializations (long-range planners, historic preservation

planners, and urban designers) has a positive and statistically significant effect of having

values that favor deliberative democracy (Johnson, 2006).

The models presented herein suggest that participation of HazMat responders in

HMCFS projects does not have a negative effect on CI selection. Previous academic

research, technical reports, and other literature identify that firefighter emergency

responders operate in "command-and-control" organizations (Donahue, 2004). These

types of organizations favor one-way communications (Cloud, 2008) and conformity

with group norms (Archer, 1999), and may be poorly suited for collaboration with other

agencies or the public (Cloud, 2008). Firefighters tend to have "guardian" temperaments

(Geldbach-Hall, 2006) that are watchful of outsiders, and exhibit low openness and

agreeableness (Fannin & Dabbs, 2003).

However, this research does not support Hypothesis 2: *The participation of*

HazMat emergency responders in planning projects will significantly decrease the

selection of communicative-oriented information. A possible reason for the lack of

evidence supporting the hypothesized relationship may be due to the measures used for

CI selection, and it is expected that the hypothesized effect would be evidenced with

more-comprehensive measures of communication. CI selection is constructed from

three underlying binary variables (described in Section 4.9.1 and Appendix A) involving

interviews with 1) local emergency responders, 2) industry representatives, and 3) and

transport carriers. This measure of CI selection was as strong as possible using the

available secondary data source. However, such communications are not fully

representative of the types of deliberations that are typically conceived of by planning

theorists between those groups or individuals in planning processes that have power

(e.g., government agencies, business groups, etc.) and those that do not (e.g., social,

environmental, community groups, etc.). As communications in HMCFS projects with

the latter types of planning participants is not measured in the CI selection variable, this

research is not able to ascertain the effects of HazMat responder participation in HMCFS

projects on these types of communications. This suggests that future research is needed

to more specifically ascertain the relationships between planning participation and

information-based communications with a broad range of community stakeholders.

Since the CI selection variable is a constructed variable for which communicative

information selection is assessed across emergency responders, industry representatives,

and transport carriers, it may also be illustrative to further examine the associations

between community planner and HazMat responder participation in HMCFS projects

and each of the underlying variables. Table 18 lists the correlations for the data set

(N = 183 cases) between community planner and HazMat responder participation in

HMCFS projects and selection of each of the three underlying communicative

information variables.

Table 18. Correlation coefficients for community planner and HazMat responder participation in the HMCFS and sources of communicative-based HMCFS information.

Sources of new HMCFS information	HMCFS Participants	
	Community planners Phi (sig.)	HazMat responders Rho (sig.)
Interviews with local emergency responders	.220 (.003)	.253 (.001)
Interviews with industry representatives	.189 (.011)	.054 (.467)
Interviews with transport carriers	.085 (.268)	.031 (.678)

Although the variable for community planner participation in HMCFS projects is

not significantly correlated with the variable for interviews with transport carriers, it is

significantly and positively correlated with variables for both interviews with emergency

responders and interviews with industry representatives. HazMat responder

participation in HMCFS projects is significantly and positively correlated only with

interviews of local emergency responders. On one hand this suggests that emergency

responders can function as an important channel to sources of information within their

domains of expertise. That HazMat responder participation in HMCFS projects is not

significantly correlated with interviews with other stakeholders may be due in part the

insular nature of emergency responders. While there is not a negative relationship for

interviews with industry or transport carriers, there is not a significant positive

relationship either. This may indicate ambivalence by HazMat responders toward interview information from non-responder stakeholders, consistent with concepts of bounded rationality (Simon, 1983), an insider/outsider perspective of emergency response cultures (Archer, 1999; Merton, 1972), and research by Tiamuyu (1992) and Byström (2002) that indicates preferences for people inside an organization as information sources. It is also possible that the survey informants indicated that HazMat responders participated in the HMCFS because emergency responders were interviewed.

The most important variable for communicative information selection for both binary and ordinal measures of the variable is that the mining and raw materials sector is a major area employer. Mining and raw materials are resource-based industries in which community planning for land use and environmental impacts is often contentious. It may be that communities with this industry sector have a greater communicative planning "capital" in which stakeholder participation in planning is encouraged or otherwise facilitated. This would suggest that a type of vicarious planning experience is available in these communities to enhance emergency planning by LEPCs. Or, there may be latent effects of specific kinds of hazards and risks that are often associated with mining and raw materials production.

An important organizational variable that describes the LEPC's conduct of HMCFS projects is whether the LEPC has ever asked for a copy of another jurisdiction's HMCFS. This variable has a significant positive effect on CI selection in HMCFS projects and is a predictor of medium importance. There are multiple potential explanations for this relationship. First, that the LEPC has reached out on one or more

occasions to other organizations to request copies of planning studies, an act of communication in itself, suggests there are organizational norms that facilitate external communications and the level of CI selection. This may also indicate the importance of a boundary-spanning function in LEPCs for promoting communicative action, consistent with findings by Brody (2003a) and Johnson et al. (2011). Second, in communicating with other LEPCs to request copies of their HMCFS, the requesting group may have interviewed emergency responder, industry, or transport carrier personnel associated with that LEPC about HazMat transport and obtained information that is also relevant to its jurisdiction. In this way, the act of requesting external information may identify potential channels and sources of information that were not considered or available before.

LEPC use of contractor knowledge/experience with the HMCFS process to guide how the HMCFS was conducted also has a significant positive effect on communicative information selection and is of medium importance. This variable suggests that 'know-how' for conducting planning projects is important. Along with the role of LEPC requests for other jurisdictions' HMCFS, it also suggests that vicarious experience plays an important role in CI selection, consistent with positive results of vicarious experience in chemical hazards planning (G. O. Rogers & Sorensen, 1991).

Several possible reasons explain why the conduct of an HMCFS by LEPC members or associates has a significant positive effect on CI selection. First, it may be an indicator of organizational investment in the HMCFS project. Rather than simply avoiding the project altogether, or waiting until scarce funds for hiring a contractor are

available, the LEPC members take it upon themselves to conduct the project. Through

the norms and values of LEPC participants (their presumed desire to do a 'good job'),

LEPC members engage in increased communication with constituents about HazMat

transportation. Or, it may be that LEPC members and their associates have direct

knowledge and experience about which community stakeholders they can or want to

interview. In this way, LEPC members might also act as channels to information

sources, or even as sources of information themselves.

Two community contextual variables have significant positive effects on

communicative information selection but are of lower relative importance. These

variables relate to hazard and risk (that the jurisdiction is a significant HazMat origin,

which has a significant positive effect on level of CI selection but not on whether CI was

selected), and location (that the LEPC is located in Texas, which has a significant

positive effect on both whether CI was selected and level of CI selection). That a

jurisdiction is a significant HazMat origin may relate to both what is known about

HazMat transport in the jurisdiction, and the perceived level of associated risk. When a

jurisdiction is a significant HazMat origin, this means that hazardous materials are being

produced and/or stored in the community. This in turn implies that the producers and

users of those materials, typically industrial facilities, are located within the community.

Since industry is an important LEPC stakeholder and participant, such facilities are more

likely to be known to the LEPC organization than when hazardous materials are only

transported through the jurisdiction. Thus, with a base level of knowledge about the

HazMat being transported, the jurisdiction can more-readily identify local entities from

which existing data can be requested than it could otherwise if those entities were not known or located outside the jurisdiction.

Texas is one of the top petrochemical processing regions in the world, and some areas of the state have extremely high levels of hazardous materials transportation. While the LEPC being located in Texas was not initially assessed as an indicator of hazards and risks, this might be considered as a possible explanation for the significance of this variable. Another possible explanation is that state-level coordinating mechanisms and emergency preparedness training in Texas might promote increased communication in LEPCs, which would suggest an agenda-setting role at state levels.

Research shows that proximity to risk is an important predictor of risk perception by individuals (Peacock, et al., 2005; G. O. Rogers, 1984), and as personal experience and knowledge about an issue increases, people are more likely to be concerned about it (Wood & Vedlitz, 2007). Perceived threats are higher for toxic chemicals than for many other types of industrial facilities (Lindell & Earle, 1983) or community hazards (Braun et al., 2006), and planning for chemical hazards in communities increases with increasing proximity to sources of risk (G. O. Rogers & Sorensen, 1991). That the LEPC organization knows that hazardous materials are being transported in a community can imply an element of perceived risk given its known proximity. To address this risk, the LEPC obtains information about HazMat transport activities by engaging in stakeholder interviews. To the degree that a jurisdiction's known or perceived HazMat transportation reflects hazard vulnerability and CI selection is a proxy for positive planning outcomes, the significance of these variables is consistent with

results observed by Lindell and Meier (1994) on effects of hazard vulnerability on planning outcomes in LEPCs, and by O'Connor et al. (2005) on effects of risk perceptions by water managers on use of weather and climate forecast information in water resource planning.

A variable associated with the LEPC organization structure—that the LEPC is a regional jurisdiction—has a significant negative effect on level of CI selection (but not on whether CI was selected) and is also of lower relative importance. On one hand, it might be expected that a regional jurisdiction would have a greater capacity for boundary-spanning across the respective communities that it encompasses, which would suggest an associated increase in CI selection. On the other hand, a larger jurisdiction creates greater challenges for interacting with diverse and distributed emergency responders, industry representatives, and transportation carriers, which would be consistent with the observed negative relationship and observations by Margerum (2008). It may be that the perceived task-complexity of collecting interview information from diverse sources in regional LEPCs is simply too great to effectively obtain information via interviews.

Overall, the maximum level of variance explained in regression models predicting communicative information was 18 percent for linear regression on level of CI selection, and 25 percent (as measured by Nagelkerke pseudo R^2 values) for whether CI was selected. This suggests that the significant variables described in this section are collectively only a small part of the important factors that explain the variance in communicative information selection. The lower amount of explained variation in the

regression models is also consistent with observations of Innes (1998) about the difficulty of isolating and describing the role of information in communicative planning—and by extension the factors influencing communicative information selection.

6.1.2 Information selection diversity

The effect of HMCFS participant diversity on measures of HMCFS information selection diversity—number of selected HMCFS information sources and number of selected HMCFS information types—is positive and statistically significant, even accounting for contextual variables. This finding supports Hypotheses 3: *An increase in the diversity of participants in planning projects will significantly increase the diversity of information sources selected*. The normative basis of communicative/participatory planning posits that increased participant diversity has a positive effect on planning outcomes, and this appears to be the general trend in evidence from empirical studies (Burby, 2003; Dietz & Stern, 2008; Selin, et al., 2000; Wassen, et al., 2011). In addition, participant diversity is of medium importance compared with other variables in the regression models. As with effects of community planner participation in HMCFS projects on communicative information selection, the strength of the relationship between HMCFS participant diversity and information selection diversity suggests that the effect of variable might not be substantially attenuated if a greater number of contextual variables are included in the analysis, either directly or by proxy through use of indices. However it should also be considered that participant diversity effects in studies reported in some extant literature were mixed (Koontz & Johnson, 2004; Leach,

2006; Leach & Pelkey, 2001) or not significant (Brody, 2003b). The limited range of

participant diversity that is reflected in this sample, the context of LEPCs, and

emergency planning in general may attenuate or modify the effects of participant

diversity on information selection diversity. Further investigation is needed to inform

the validity of this research outcome.

As with communicative information selection, community and regional measures

and variables of note are associated with hazard and risk (that the jurisdiction is a

significant HazMat origin, of medium relative importance) and economic basis (that the

mining and raw materials sector is a major area employer, of low relative importance),

and have significant and positive effects on information selection diversity measures. As

with communicative information selection, these variables suggest that the presence of

hazards and risks, knowledge and expectation of hazards and risks, and/or vicarious

experience are among the drivers of information seeking behavior in planning

organizations. To address known hazards and risks, the LEPC seeks information not

only through communicative mechanisms but from a diverse range of information

sources.

Organizational knowledge and experience are also important for increased

information selection diversity, consistent with results for communicative information

selection. Whether the LEPC has ever asked for a copy of another jurisdiction's

HMCFS is of high importance relative to other variables in regression models, and that

other HMCFS were used to guide how the LEPC's most-recent HMCFS was conducted

is of medium importance. Both of these variables have significant positive effects on

information selection diversity and suggest possible mechanisms of organizational norms and values, boundary-spanning and/or vicarious experience in enhancing information selection in LEPCs, as described for communicative information selection. Vicarious experience aspects of these results are also consistent with positive effects of vicarious experience in chemical hazards planning as observed by Rogers and Sorensen (G. O. Rogers & Sorensen, 1991).

The LEPC's direct experience with conducting HMCFS projects, indicated by the number of years that projects were conducted, is also of medium importance. This variable suggests that LEPCs with increased planning activity may have greater access to or knowledge of information sources, and that the role of direct experience and internal know-how in the LEPC organization can increase over time. In addition, HMCFS information from previous years' studies can act as a baseline information source and provide information for subsequent studies about project approaches, even if a completely new set of project participants is involved. In this way documentation of prior studies can also function as a source of vicarious experience for the LEPC.

As with communicative information selection, the possible positive relationship exhibited between use of contractor knowledge/experience as a guide for HMCFS conduct and the number of selected HMCFS information sources also suggests a role of vicarious experience and know-how in these processes. However, this relationship is of low relative importance and is only significant in one regression model (for number of selected information sources) which included the HMCFS project funding variable, described further below.

Increasing the amount of funding for HMCFS projects has a significant positive effect on HMCFS information selection diversity, and on average when it is included in regression models this variable is of high overall importance relative to other variables. Funding enables an LEPC to provide nominal compensation for participant time and effort, or provide reimbursement for travel costs or other incidental costs, thereby increasing the level of personnel available to assist data collection and processing. Alternately, and in many cases more likely, when sufficient funding is available the LEPC is able to afford a contractor to conduct data collection. This is especially relevant for collection of data through technical surveys or gathering of other technical data, and may explain why this funding variable is not a significant predictor of communicative information selection.

The models predicting number of selected information sources suggest a possible positive relationship between the involvement of participants in HMCFS projects because budget to hire a contractor was not available and information selection diversity. However, this relationship was not significant in all models. While lack of funding is a barrier for activities of organizations (including LEPCs), such a relationship may indicate that individual commitments to participation (their norms and values) in planning organizations can help overcome funding limitations. However, this variable is less important than most other contextual variables, including funding for HMCFS planning projects described above.

That the LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials is not of significant relative importance in the models of

information selection behavior, although the variable has a low level of statistical significance for a positive effect on number of selected information types in some but not in all regression models. Similar to organizations with boundary spanning mechanisms, this indicator of organization openness might suggest the possible role of organizational norms and values on information behaviors.

The natural log transformation of jurisdiction population is not of significant relative importance in the models of information selection behavior, although the variable has a low level of statistical significance for a negative effect on number of selected information types in some but not all regression models. It is unclear why a negative relationship would be exhibited, but it may be that population size is an indicator of other latent factors associated with community populations. For example, a potential explanation may be that as population increases, the task complexity of planning drives participants to utilize fewer types of information. Comparatively, the amount of information associated with any single source or type may be greater for higher population jurisdictions than for lower population jurisdictions, overwhelming the capacity of the planning resources.

Two other variables related to administration of the survey and survey informants are that the survey was distributed through the SERC rather than directly by the LEPC, and that the informant's role was in an LEPC leadership position, respectively. However, affects of these variables do not appear to attenuate the direction or significance of independent or contextual variables with dependent variables in regression models.

Overall, the linear regression models predicting information selection diversity explain around 30 to 35 percent of the variance in the dependent variable, increasing to around 40 percent with inclusion of the project funding variable. Together, these findings suggest that the limited number of significant variables described in this section collectively explain a moderate amount of the variance in information selection diversity, but that other measures of information selection diversity are not accounted for in the models.

6.1.3 Discussion summary

As to questions of whether normative theories of communicative-rationality are appropriate for describing behavior in specific aspects of planning practice and across public planning disciplines, this study provides partial confirmation. A middling share of LEPCs that conduct HMCFS projects reported using interviews with key organizational stakeholders as information sources. Elements of communicative-rational theory that were important in this study include participation of community planners in HMCFS projects. The education, training, and practical experience of community planners—their norms, values, and temperaments as civic bureaucrats and know-how for obtaining and interpreting communicative information—appear to help promote engaging stakeholders through interviews, thereby providing opportunities for two-way communications and obtaining subjective information that might not be otherwise available. Community planners may also function as information channels to identify community stakeholders for interviews. HazMat responders did not have a negative effect on overall communicative information selection, and it appears they may function

as channels to communicative information sources specific to their domain. Another indicator of communicative action, that LEPCs engaged in boundary-spanning by requesting information from other LEPCs, also promoted communicative information selection.

Aside from interviews with emergency responders, industry representatives, and transport carriers, other sources of communicative-based information (e.g., stakeholders such as social or environmental groups in the community) do not appear to be utilized by LEPCs in HMCFS projects. LEPC informants did not indicate that such sources were used when prompted for other sources of "new" information in the survey. From the perspective that "communicative practice is the interaction between the individuals (or quasi-individuals) who are participating in the planning process" (Alexander, 1998), the information sources considered in this study are consistent with communicative-based interaction. However, the use of interviews does not in itself fully satisfy the principles of communicative rationality that dialogical exchanges be truthful and free from strategic information distortions. Also, interviews with a selective set of community stakeholders that are important to chemical hazards planning and response does not represent the perspectives of disenfranchised and unempowered community members as envisioned by many communicative action theorists. Further research on the nature of information communications in these interviews and interviews with other community stakeholders is needed to better inform outcomes of communicative information selection in LEPCs.

Another research outcome related to the tenets of communicative rationality and participatory planning is that an increase in HMCFS participant diversity has a significant positive effect on HMCFS information selection diversity. This effect is positive and significant in this research, and it is of medium relative importance among the community and organizational variables that were considered. There is generally positive albeit mixed evidence regarding the effects of of planning participant diversity in the literature, and this outcome should be investigated further.

Figure 9 illustrates a combined theoretical model of information selection in emergency planning projects that incorporates constructs from models of communicative information selection and information selection diversity for HMCFS projects. The combined model identifies constructs that this author interprets as being of primary and secondary theoretical importance for predicting communicative and participatory information selection behavior, and the paths through which the constructs are applied. The combined model assumes that constructs associated with the community and region, planning organization, and planning participants affect information selection in a sequential manner, with community and regional constructs being most-distal and planning participant constructs being most-proximal to information selection.
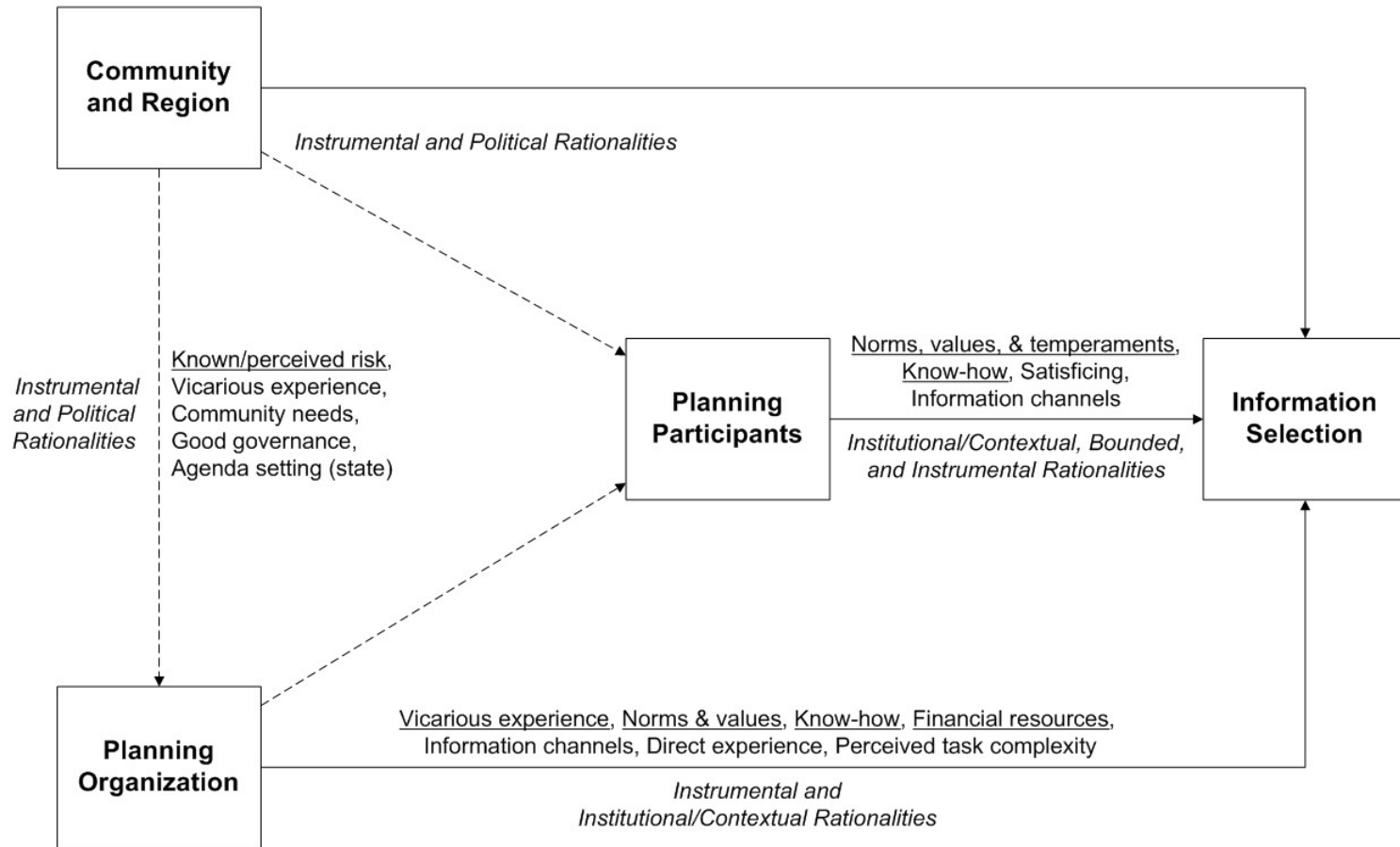
Figure 9. Model of information selection in emergency planning projects.

6.1.3.1 Exploratory discussion of alternate rationalities

While constructs of communicative and participatory planning appear to have some utility for describing emergency planning practice, a number of other theoretical constructs are possibly evidenced as well. The model in Figure 9 shows theoretical abstractions associated with four other types of descriptive rationalities that are found in extant literature. These are institutional/contextual rationality, bounded rationality, instrumental rationality, and political rationality.

Institutional/contextual rationality is related to the socio-cultural contexts of institutions as described in Section 2.5. In this form of rationality, institutions such as professions and organizations influence the collective behavior of institutional members, in spite of their individual differences, by creating a common framework of norms and values. In addition, institutional contexts influence the way people identify their sense of self, acting to strengthen salience and adherence to norms across the institution (Hogg & Terry, 2000). Institutional/contextual rationality is seen most strongly in relationships between planning participants and information selection, as discussed in paragraphs above. Planning participants do indeed appear to "stand where they sit" when it comes to information selection preferences, within limits of bounded rationality. Institutional norms are seen acting on information selection through boundary spanning by the planning organization.

The preceding discussions illustrate how normative communicative rationalities are implemented in practice through institutional/contextual rationality. That is, the norms, values, and temperaments of different types of participants and organizations

appear to be important drivers in the approaches to planning that are selected. Some participants—particularly community planners—have education, training, and experience in communicative processes, while other participants—such as emergency responders and industry representatives—function as information channels through which at least some communicative action is able to be achieved.

Bounded rationality (March & Simon, 1958; Simon, 1983) refers to the cognitive and technological limitations that people and organizations have for information processing. Rather than seeking the most-optimal information, people satisfice by selecting the most-expediently available information, or information that will do a "good-enough job" (Choo, 2007; Simon, 1983; Warwick, et al., 2009). Bounded rationality appears most directly applicable in this study to the activities of planning participants such as HazMat responders, but the literature points to bounded behaviors of organizations as well.

Instrumental rationality refers to getting things done in the best or most-effective way possible (Simon, 1983). Instrumental rationality is evident in the planning organization's vicarious use of other LEPCs' experience and previous studies, its direct experience and use of expert guidance that provide know-how, use of financial resources, and use of information channels. In individual planning participants, instrumental rationality is seen to have a less-direct effect, but instrumental behavior via community and organization paths does influence them. Implementation of communicative planning approaches is achieved instrumentally by use of information channels that involve communications and interactions.

Political rationality has been described as acting on individuals' political ambitions, as well as the role of government in society—the latter of which is of primary interest in this study. Foucault (1979), Giddens (1995), and others trace the historical evolutions of political rationalities. A current understanding of the term is that political rationality is the actions of the 'state' to promote the well-being of constituents and/or preserve its own positions (Foucault, 1979). Political rationality is indicated in the response of planning organizations to community and regional characteristics, attitudes, and behaviors. Even community planners, whose primary organizational clients are the community, "tend to make decisions which justify and maintain their own position and power. Government decisions represent the interests of the group in power first, and a total public second" (Bolan, 1971, pp. 386-387).

Communicative rationality is utilized in politically rational behavior. Addressing apparent community needs is important in this pathway, and planning organizations and local agencies appear to be responsive to the hazards and risks their constituencies are exposed to. Other influences are utilization of 'good governance' approaches, and agenda-setting by the state.

6.2 Implications and Recommendations

6.2.1 Generalizability

This research is based on analysis of self-reported data from a national sample of LEPCs. There is reason to expect that the LEPCs in the research sample are among the more proactive LEPCs in the national population. In a given year, only a small proportion of LEPCs conduct HMCFS or similar projects such as risk, hazard, and

vulnerability assessments. The fact that an LEPC—a multi-jurisdictional, predominantly volunteer, boundary organization with limited resources—conducts such a project suggests it is likely to be functioning "ahead of the curve" compared to other LEPCs around the country. Also, responding LEPCs in the research sample were self-selected, using a survey instrument that was distributed by e-mail and conducted via the Internet. Although e-mail and Internet access were commonplace at the time the survey was conducted (in the Summer of 2008), the survey would not have been distributed to LEPC "laggards" who had not yet implemented this technology in their organizations (E. M. Rogers, 2003). LEPC informants had to have sufficient interest and attention to open the e-mail invitation to participate in the survey, follow the Internet link, and provide responses to survey questions. Thus, LEPCs and their representative informants who lacked technology, interest, and/or attention were not represented in the research sample.

If this study were concerned with explaining the information behavior of all U.S. LEPCs, the results might be less generalizable. However, the results are not oriented toward such a population. The results point to behaviors of active, engaged emergency planning organizations and other local planning consortiums. These are the types of entities that one would expect to be using planning information, rather than those that make do with little or no information whatsoever. Inherent to generalizability of this research is the interpretation that survey responses represent those of any given active LEPC organization (or other planning consortium), rather than those of an individual informant from an LEPC in a certain state or region.

The accuracy of self-reports is a concern in many research studies, and this study is no different. With this in mind, this study takes the perspective of Kuhn and Nelson (2002) in their study of conflict in an urban planning organization. This perspective is that it is not so much the accuracy of the actual behavior that is represented in self-reports, but the 'collective cognitive structure' of informants that is drawn upon in describing the actual activity that occurred. The findings of this study are generally consistent with those of numerous other studies in planning, organization science, information science, public policy and administration, and other literature, which lends credibility to the results.

This research borders on the exploratory—the literature review did not identify any empirical study of information selection that has used a national sample of planning organizations, much less such a study within the context of emergency planning organizations or LEPCs. Further, this research incorporates concepts from several different but related academic fields, not just planning. However, the results do suggest implications for emergency planning (including LEPCs) as well as planning theory and practice. Section 6.2.2 covers recommendations that are more narrowly applicable to emergency planning practice. Section 6.2.3 covers recommendations for planning theory and practice in general.

6.2.2 Recommendations for emergency planning

Recommendations for emergency planning, listed in Table 19, are based on the premise that planning organizations can choose how they address uncertainty, that the methods they choose impact the quality of planning outcomes (Kartez & Lindell, 1987),

and that more communicative information and diverse information in planning processes can lead to better planning outcomes. Table 19 summarizes significant variables from this research in terms of their *potential* for change that can positively affect information selection in HMCFS projects, and their *likelihood* of positive change. Policy *targets* identify variables that are more amenable for addressing change through policy, and policy *recommendations* identify specific mechanisms by which positive change in information selection behavior might be enabled. Discussion of these recommendations about emergency planning participants and other variables is provided in the paragraphs that follow.

The planning participants listed in Table 19 have important conceptual and/or empirical relationships with information selection behavior in this study. These participants have a medium-to-high potential for change that can positively affect information selection in HMCFS projects, in that the mean values for these variables are on lower ends of their maximum scales as measured in this study. With encouragement and guidance by federal and state agencies, there is a medium likelihood of positive change for planning participation.

Table 19. Emergency planning information selection potential for and likelihood of change, and policy recommendations.

Measures and Variables	Change Potential	Change Likelihood	Policy Target	Policy Recommendations
Planning Participants				
Local planning agency/authority employees participated in HMCFS	Med.	Med.	Yes	• Federal and state agencies should promote community planner participation in emergency planning projects, continue to promote broad stakeholder involvement in planning, and promote responder engagement with other community stakeholders (including but not limited to community planners) in emergency planning projects.
HazMat responders participated in HMCFS	High	Med.	Yes	
Diversity of HMCFS participants	High	Med.	Yes	
				• Federal and state agencies should include published HMCFS and emergency planning guidance with grant information and consider developing enhanced guidance that focuses specifically on stakeholder engagement in volunteer agencies and in emergency planning contexts.
				• Local emergency planning agencies should engage community planners and involve them in planning activities. Local emergency planning agencies should ensure that the appropriate range of relevant stakeholders is included in emergency planning processes.
				• Community planners should become involved with local emergency planning agencies, utilize their training and expertise in working with diverse information sources, and seek out ways that mutually beneficial planning projects can be implemented.
Planning Organization				
LEPC has ever asked for a copy of another jurisdiction's HMCFS	High	Med.	Yes	• Federal and state agencies should include published guidance with grant information that promotes small projects which can be conducted in multiple years, and make grant funding mechanisms more flexible to facilitate multi-year activities.
LEPC members or associates conducted the HMCFS	High	Low	Yes	
Number of years in which LEPC has conducted HMCFS	Med.	Low	Yes	• Federal and state agencies should provide incentives that encourage key emergency planning participants to maintain involvement in their organizations on a long-term basis.
Contractor knowledge/experience with the process was used to guide how HMCFS was conducted	Med.	Med.	Yes	
				• Federal and state agencies should include published guidance with grant information that promotes information seeking, information sharing, and coordination across jurisdictional boundaries. Local planning agencies should ensure that this emergency planning
Amount of non-local funding for HMCFS, per thousand population	Low	Low	Yes	
LEPC is regional jurisdiction	Low	Low	No	

Table 19 continued. Emergency planning information selection potential for and likelihood of change, and policy recommendations.

Measures and Variables	Change Potential	Change Likelihood	Policy Target	Policy Recommendations
				guidance is followed when projects are conducted by external entities such as contractors.
				• Federal agencies should make available sample HMCFS/emergency planning documents that can be securely downloaded via Internet.
				• Federal and state agencies can make additional funding available to local entities for emergency planning.
				• Federal agencies should develop and provide guidance on volunteer organization funding with specific attention to implementation in LEPC and other emergency planning applications.
				• Federal and state policy should require or recommend that procedures for conducting HMCFS outlined in published guidance be followed as a condition of grant funding.
				• Federal and state agencies should compile a list of qualified private, university, and government planning contractors.
				• State agencies can provide extension personnel to assist LEPCs and emergency planners with obtaining funding. Local planning organizations can identify long-term personnel and coordinate with state and federal agencies to receive training on funding.
				• Local planning agencies should conduct emergency planning activities in increments, to reduce the burden of conducting a more extensive project in a limited timeframe such as a fiscal year.
				• Local planning agencies should develop planning processes and projects among multiple participants to ensure continuity of knowledge upon personnel or membership changes.
				• Local planning agencies should request emergency planning information from adjacent jurisdictions to identify the extent of existing knowledge about risks in the jurisdiction and need for additional planning information.

Table 19 continued. Emergency planning information selection potential for and likelihood of change, and policy recommendations.

Measures and Variables	Change Potential	Change Likelihood	Policy Target	Policy Recommendations
Community and Region				
Level of agreement that conducting HMCFS has had support of local politicians	Low	Low	Yes	• Federal and state agencies should include published guidance with grant information and develop additional guidance that describes how local entities can identify priority corridors for HMCFS and other emergency planning activities, and the potential methods of data collection that are applicable and relevant.
Mining or raw materials sector is major area employer	Min.	Min.	No	
Jurisdiction is sig. HazMat origin	Min.	Min.	Yes	• Federal, state, and local entities should engage local politicians about the importance of emergency planning activities, including a strong fact-basis for planning such as HMCFS.
LEPC is located in Texas	N/A	N/A	N/A	
				• Local entities should take advantage of institutional planning capacities that can be found in other community processes, agencies, and organizations.

Min. = Minimal; Med. = Medium; N/A = Not Applicable

Federal and state agencies should promote community planner participation in emergency planning projects through guidance documents. Planners are experts in collecting and processing planning information in general, and the ways of transforming information into knowledge. Planners also have expertise in communicative and participatory planning processes. As a function of their roles in communities, their education, training, and experience, and their values and ethics, planners have broad understandings of the needs of their communities, and may have greater independence from potential information distortions than other emergency planning stakeholders.

Current federal emergency operations planning guidance, *Comprehensive preparedness guide (CPG) 101 Version 2.0: Developing and maintaining emergency operations plans* (FEMA, 2010), is a primary guidance document for local emergency planning. It identifies community planning agencies as sources of planning information but does not recommend them as core planning team participants. Community planners should be included among core planning team members, in addition to hazard mitigation specialists that are currently recommended for core planning team membership.

The *Guidebook for conducting local hazardous materials commodity flow studies* (Bierling et al., 2011), which was published in 2011 by the Transportation Research Board of the National Academies, lists planning agencies and metropolitan planning organizations among potential core team members. This recommendation can be strengthened to highlight the education, training, and experiences that community planners bring to the planning process. A link to this guidebook has been provided by PHMSA on HMEP Grants Web pages, and information about its availability should be

provided by U.S. DOT and SERCs to HMEP Planning Grant recipients. This guidebook was commissioned to update U.S. DOT's technical guidance on conducting HMCFS, and there is a heavy emphasis on technical data sources. Communicative-based information sources are addressed briefly in the guidebook, but additional guidance could be developed that LEPCs and emergency planners can use for obtaining communicative information about HazMat transport issues from community stakeholders.

Local emergency planning agencies should engage community planners and the broad range of relevant community stakeholders and involve them in emergency planning. Local community planners should also seek out ways to become involved in emergency planning efforts. Not only can they provide a valuable contribution as information experts and promote professional legitimacy of planning practitioners (Campbell & Marshall, 1999), but they can provide perspectives and obtain information about population proximity to sources of risk, cargo transportation, and hazard mitigation needs that is relevant to broader community planning efforts (Pearce, 2005). These recommendations are consistent with the call by FEMA Administrator Fugate for emergency managers and community planners to seek ways "to jointly determine what shared values and potential solutions work best for their community" (J. C. Schwab & Topping, 2010, p. iii).

Participation of HazMat responders in HMCFS projects does not appear to have a significant positive effect on the broad measures of communicative information selection in this research. However, the recommendations do not suggest that these

personnel or other emergency responders should not be involved in emergency planning projects. First, HazMat responder participation does appear to facilitate information selection that is particularly relevant to and obtained from their respective professions and agencies—through interviewing emergency responders. Second, they are subject matter experts who may not necessarily facilitate selection of other types of information, but can certainly provide input regarding utility and relevance of information for emergency planning and response. Third, emergency responders are key stakeholders with vested interests in planning outcomes. Through their involvement in planning projects, they can become better familiar with the specific processes and procedures by which planning information is obtained. This familiarity and understanding can increase the relevance and meaning of planning information for its intended applications and promote its implementation in emergency planning, training, and response.

Table 19 lists other policy recommendations for organizational and planning project factors. Many recommendations are associated with ensuring that emergency planning guidance is made available by federal and state agencies to local planners, and ensuring that local planners utilize and implement procedures and recommendations outlined in the guidance. Other recommendations suggest development of additional planning guidance that is focused on membership, communication, and knowledge retention in volunteer and emergency planning organizations, and providing resources and processes by which local entities can implement such guidance. A key element of this is that local entities identify multiple personnel within planning organizations and consortiums such as LEPCs that are likely to be involved on a long-term basis. These

personnel can function as storehouses of knowledge and experience within the organization and help transfer that knowledge to other members.

Funding is another important aspect of policy recommendations. Federal and state agencies can make additional funding available for emergency planning, and increase the flexibility of timing for funding utilization from existing grant sources. They can provide extension personnel and training to local entities on how to obtain emergency planning funding from federal and state grant sources as well as local or internal funding sources. This is especially important for match-funding mechanisms.

Finally, local emergency planners should avoid satisficing in selecting planning information sources because of a) preconceived ideas about risk, b) convenience of conventional knowledge, c) inconvenience of new information and associated responsibilities, or d) the potential of upsetting the proverbial apple-cart of local power-brokers. This can be enabled by following processes that are laid out in emergency planning guidance. Federal and state entities can encourage local entities to carefully follow recommendations and guidelines as they apply to local conditions. One mechanism by which this might be accomplished is by making funding for planning projects contingent upon a demonstration that planning recommendations and guidelines will be considered and followed to the degree practicable, and confirming that this was done at the conclusion of the project. Key to ensuring that such measures are not rigidly instrumental—and thereby become barriers rather than incentives—are funding programs that are flexible, and funding administrators who are knowledgeable about the types of local organizations they are enabling and the respective conditions in which

local organizations operate. Good governance needs to happen at all levels, not just locally.

6.2.3 Recommendations for planning theory and practice

Section 6.1.3.1 describes how normative theories of communicative rationality may also be exhibited in information selection behavior through four types of descriptive rationalities: institutional/contextual, bounded, instrumental, and political. Four recommendations are based on these conceptualizations and form an exploratory prescriptive framework for planning theory and practice:

1) Planning should be institutionally-professional, not parochial.

2) Planning should be maximizing/optimizing, not satisficing.

3) Planning should be instrumentally-adaptive, not rigid.

4) Planning should be proactive/responsive, not political.

6.2.3.1 Planning should be institutionally-professional

Separate domains of practice enable local government agencies and the private sector to provide effective and efficient services to communities. However, parochialism and protection of turf within organizational boundaries can lead to myopic planning that inhibits comprehensive, long-term sustainability. An institutionally-professional approach considers the tasks that are required for a given planning process, and places those people who have the education, training, and experience for achieving those tasks—their institutional professionalism—in key leadership roles.

Federal guidance and local administrative structures often place a community's emergency planning functions under the primary responsibility of emergency responders

and emergency managers, who frequently have paramilitary-type backgrounds.

Community planners are almost an afterthought in federal emergency planning guidance,

as well as in local emergency planning administration in many communities. This

makes sense at first glance: community planners and responders think differently and

talk in different languages. However, in addition to HazMat response concerns that

affect responders, hazardous materials impact community planners in other important

ways as well, such as facilities siting, environmental permitting and cleanup, policy

developments, hazards inventories, legal and liability issues, pollution prevention, and

water supply protection (Andrews, 1987). In addition, emergency planning is more than

response operations, it also includes prevention, protection, recovery, and mitigation. At

least three of these dimensions are long-term efforts that require engaging diverse

stakeholders, extensive information collection, systematic analysis, collective

envisioning and alternatives generation, and interdepartmental collaboration. The

norms, values, and temperaments of responders and related professionals (such as

emergency managers) might not be oriented toward these kinds of tasks, but these are

exactly the kinds of tasks that planners are oriented toward.

The institutional professions and functions of planners are to plan, just as the

institutional professions and functions of responders are to respond. This is not to say

that responders do not have a key role in emergency planning, they do! But it makes

little sense if community planners do not have a key role in local emergency planning

either. An institutional-professional approach suggests that community planners should

have key roles in all aspects of planning that occur in a community, not just select

domains. Similar analogies are likely applicable to other community domains that have planning functions, such as utilities and infrastructure planning for example.

6.2.3.2 Planning should be maximizing/optimizing

Cognitive abilities of planners and those in planning organizations, available technologies and resources, and spatial and temporal boundaries limit the selection of information, generation of knowledge, and identification of alternatives for use in planning and decision-making. However, satisficing occurs when planners and decision-makers settle for a "good-enough" process or outcome rather than the best obtainable process or outcome. A maximizing/optimizing approach utilizes the best obtainable approach to planning and decision-making, within the constraints that bound potential options.

Although recent emergency planning guidance calls for planners to use all available information, this synoptic ideal is unrealistic. Not only are planning timeframes and resources limited, but collecting and analyzing all possible information is practically impossible. The question is not whether all information should be included, but what kinds of information should be included. A maximizing/optimizing approach considers what information is available, its expected utility and equity for generating knowledge and alternatives, the means by which information can be obtained, and the resources and procedures that are available to obtain it. Based on such an approach, information selection can be better targeted not only toward specific types of information, but also to include different types of information that can be used to evaluate validity and truth-claims. By identifying and targeting information sources,

planning organizations can better maximize the utilization of scarce resources and limit passive assimilation and implementation of information that is irrelevant and ill-suited to planning and decision-making (cf. Bierling, et al., 2011; G. O. Rogers, et al., 2010).

6.2.3.3 Planning should be instrumentally adaptive

Guidelines for and experience with the planning process are important for knowing how to "get things done" and achieve planning objectives. However, planners can fall into a trap of following a cookie-cutter approach to the planning process or simply doing things because they have been done that way before. Except for the most routine tasks, few if any guidelines will be exactly matched to a given planning application, and conditions and needs change over time and in different locations, even in very local settings. An instrumentally-adaptive approach avoids rigidly following recommendations of planning guidelines and precedents of planning experience, and adapts know-how to the conditions and needs of the planning application.

Sustaining a reasonable level of planning activity over time can help organizations such as LEPCs and other planning consortiums maintain an instrumentally-adaptive planning process. By engaging in a given planning effort (and at the same time limiting scope of the effort so the project is feasible), and applying know-how to subsequent efforts, planning organizations can keep planning processes feasible and planning information current. At the same time, they can help develop an intellectual capital among their memberships. This type of approach has a rich tradition in emergency response and military agencies that utilize "lessons-learned" and after-action analyses to improve response protocols and tactics. Yet, few LEPCs sustain

planning activities consistently over time, and projects such as HMCFS are often conducted in a disjointed manner.

Ten or fifteen years may pass from the last time a planning study was conducted, and over that time the community's population, local and regional transport patterns, and planning needs change. Organizational leadership and planning participants that were involved in previous studies are no longer involved or available. In response to a pressing need or uncertainty, the planning organization that attempts to comprehensively evaluate planning information for the entire jurisdiction faces new situations and institutional knowledge gaps. To achieve a quick response, planning participants might follow recommendations in a planning guideline "to the letter" or base their planning process on what a neighboring jurisdiction did. However, such approach does not recognize that local conditions vary over time and space. It is likely to result in excessive and/or inadequate information selection, perhaps both at the same time. An instrumentally-adaptive approach can help organizations conduct planning that is appropriate to local conditions and needs, and maintain active and involved memberships as well (cf. Bierling, et al., 2011; G. O. Rogers, et al., 2010).

6.2.3.4 Planning should be proactive/responsive

The political nature of planning and decision-making is widely documented, even when it comes to selection of what information is to be considered in the process. Planners are encouraged to recognize that planning occurs in political contexts, and that the influence of political rationalities, for better or worse, is unavoidable. A

proactive/responsive approach builds on strengths of community support and political processes and helps mitigate potential threats and weaknesses to planning.

Planners have an ethical responsibility of serving the public. When planning is responsive to the conditions and needs of the community at large, planners are likely to engage in governance practices that promote the common good. Local officials and government agencies are sometimes accused of "having their heads in the sand" when it comes to problems such as addressing the hazards and risks that communities are exposed to. Not only might they be responsible for doing something about the problems if information about them becomes available, but they are afraid that the public will react irrationally when it learns about them. When information about problems is transformed into public knowledge, it can become a powerful tool that can be used to challenge conventions, entrenched or politically acceptable knowledge, existing power structures, and erroneous conceptions about the way things should be. When planning is proactive, planners learn to recognize and address attempts at information subversion, which can help them fulfill their professional obligations.

6.2.3.5 Relevance to planning theory and practice

The elements of the planning frameworks described above are based on analysis of measures and specific variables and their associated constructs that affect planning information selection in a sample of active U.S. emergency planning organizations. This study indicates that community planners can have important roles in emergency planning when they are enabled through their institutional-professional norms and values. It shows that although information selection is bounded, especially for some types of

agencies, planning organizations can engage in boundary-spanning behavior. It demonstrates that instrumental know-how and experience are important for promoting increased information selection in planning projects. It also suggests that planning organizations and participants respond to political rationalities that are driven by their community planning needs. For LEPCs, these needs can be exhibited through the presence and perception of local hazards and risk.

None of these outcomes are especially surprising. However, the importance of these frameworks is not in based on the novelty of the concepts. Their importance is rather based on empirical evidence across a sample of U.S. planning organizations, and through the extension of theory not only to planning practice in general but to a venue of practice (emergency planning) that is not traditionally considered in planning studies. This research speaks to the theory of planning through its relevance to the planning process and activities of community planners, its power to explain how planning can be, should be, and sometimes is done in practice, and its potential for guiding planning and decision-making in communities. It also speaks to the practices of planners and planning by recognizing the contributions that planners and other stakeholders make to the planning process in different venues, and by describing ways in which community planning processes are effective and can be improved.

6.2.3.6 Specific recommendations for planning theory and practice.

Table 20 lists observations from this research and associated theoretical constructs that affect information selection—and by extension the planning process. Prescriptive theory and recommendations for planning practice associated with the

normative frameworks described in this section are identified in Table 20 for each of the research observations. Some of the recommendations focus specifically on improving the fact-bases of local planning projects. Planning fact-bases should be as diverse as possible, given resource limitations. This will help promote assessments of information validity and relevance for the planning problems it will be used to address. Selection of fact-bases should be oriented to planning contexts, goals, and tasks. A prior assessment of the strengths, weaknesses, opportunities, and threats inherent to the context and tasks will help steer planning organizations toward relevant information.

Other recommendations focus on challenges and opportunities associated with planning participation. It is especially important that planning entities recognize the role of socio-cultural influences on planning participants. Planning benefits from diverse planning perspectives and knowledges, and principles of democratic deliberation require that affected stakeholders are effectively represented. At the same time planning participation requires effort and resources. Participation should be appropriate, including those who can meaningfully contribute to the process, but sufficient resources are also needed to support effective participation. Because of the effort and resources that are necessary not just for participation but planning in general, it is important that the beneficial practices of planning organizations be developed and maintained to promote sustained planning capital.

Table 20. Research observations, prescriptive theory, and recommendations for planning practice.

Research Observations	Descriptive Theoretical Constructs	Prescriptive Theory and Recommendations for Practice	Prescriptive Theoretical Constructs
Information seeking in planning occurs beyond minimal levels, even in highly technical projects, yet satisficing also occurs.	Satisficing; Information channels	Planning fact-bases should be as diverse as practicable and relevant. Planning processes require multiple inputs to evaluate fact-bases for validity, consistency, meaning, relevance.	Planning should be maximizing/optimizing
The organizational, professional, and personal norms, values, and temperaments of planning participants affect the planning process.	Norms, values, & temperaments	Planning should recognize that participants 'stand where they sit.' Different perspectives and practical knowledge can be legitimate and useful in public planning processes, and some perspectives and types of knowledge are more useful than others.	Planning should be institutionally-professional
Increased participant diversity has positive effects on planning outcomes. Effects of specific participant types on specific planning outcomes may be stronger.	Norms, values, & temperaments; Information channels	Planning participation should be appropriate. Participation for theory's sake may be ineffective or harmful. Participants who represent different perspectives and contribute constructively to the planning process are especially important.	Planning should be institutionally-professional
Guidance from expert sources affects how planning organizations and participants conduct planning projects.	Vicarious experience; Know-how; Norms & values	Planning should utilize external knowledge, expertise, and other resources. Learning from the experiences of others can help planners identify what to do and what not to do, and help make their own planning processes more effective, efficient, and relevant.	Planning should be instrumentally-adaptive
Organizational experience, knowledge, and understanding affect the planning processes.	Know-how; Direct experience; Vicarious experience; Personnel resources	The organization's capacity to conduct planning processes should be developed and maintained. Learning takes place through experience, leading to knowledge and understanding about how to conduct planning processes more effectively and efficiently.	Planning should be instrumentally-adaptive

Table 20 continued. Research observations, prescriptive theory, and recommendations for planning practice.

Research Observations	Descriptive Theoretical Constructs	Prescriptive Theory and Recommendations for Practice	Prescriptive Theoretical Constructs
Financial resources for planning affect the different types of fact-bases that are obtained.	Financial resources	Planning resources should be consistent with the planning task. As with physical infrastructure, development of decision-making infrastructure development requires investment. Planners should make sure that local decision-makers are aware of relationships between planning needs, required resources, and desired outcomes.	Planning should be maximizing/optimizing
What is known and expected about the need for planning affects the fact-bases that are selected.	Known/perceived risk; Community needs; Perceived task complexity; Good governance	Planning should be applicable to its needs. Selection of the fact-bases in planning should be based on assessment of planning goals and objectives, prior planning knowledge, available sources of information and mechanisms to obtain relevant information.	Planning should be maximizing/optimizing
Selection of fact-bases in planning is dependent on the local context.	Known/perceived risk; Community needs; Good governance; Information channels	Planning should be relevant to its setting and context. Strengths, weaknesses, opportunities, and threats inherent to the setting and context should be identified and accounted for in planning processes.	Planning should be maximizing/optimizing, instrumentally-adaptive, and proactive/reactive

The majority of these recommendations are expected to be useful in any given planning effort. As with the four elements of the overall prescriptive planning framework described in this section, the strength of these recommendations lies in their empirical bases, their utility across planning domains, and their ability to both describe and improve the practice of planning. However, further research is needed to determine whether and how other organizational information selection and decision-making processes illuminate this framework as well.

7. CONCLUSIONS

7.1 Summary of Research

This research uses survey data from a sample of 183 proactive local emergency planning organizations about their conduct of emergency planning projects. The context of the research concerns activities of local emergency planning committees in predominantly county-level jurisdictions across the United States, although municipal and regional LEPCs were also included. The setting of the research is LEPCs' conduct of hazardous materials commodity flow studies, a type of planning project that can inform a wide range of local emergency planning objectives. The survey was developed by Texas A&M University and Texas Transportation Institute and administered in the summer of 2008 via the Internet, using the Tailored Design Method. The overall response rate for the survey from which the research sample was drawn was at least 23 percent.

The objective of the research is to identify the effects of planning participants on selection of planning information, controlling for organizational and community contextual variables. This research adopts the perspective that constructs of normative planning theory—communicative rationality—can be extended to individual aspects of the planning process, including the selection of planning information. Information is a formative component of any planning process, and the information that is selected affects the subsequent development of knowledge and generation of alternatives. The

dependent variables for this research include communicative information selection and information selection diversity.

This research also adopts the perspective that the socio-cultural norms and values of institutions such as organizations and professions affect the behaviors of their members in a systematic manner. Thus, different types of professionals and public agency members, such as community planners and HazMat responders, are expected to exhibit different information selection behaviors. The independent variables for this research include community planner participation in HMCFS projects, HazMat responder participation in HMCFS projects, and HMCFS participant diversity.

This research is one of the first empirical studies to use quantitative, multivariate analyses of a national sample for evaluating specific actions of planning organizations in a consistent context shared the organizations that are considered in the study. Statistical calculations use multiple linear regression and binomial logistic regression to evaluate relationships between the dependent variables and the independent and contextual variables. Regression models use sequential ordering of variables, from sets of variables that are most-distal to the dependent variables at the community and region levels, then adding organizational variables, then the planning participant variables that are most-proximal to information selection dependent variables. It also accounts for potential biases associated with survey informants and survey administration.

Three central questions for this research focus on the relationships between planning participants and planning information selection. These three questions are tested using three research hypotheses. The first central research question focuses on

whether participation of community planners in planning projects has an effect on selection of communicative information. Hypothesis 1 posits a significant positive relationship between community planner participation in planning projects and selection of communicative information. There is statistical evidence in the research sample to support Hypothesis 1—community planner participation in HMCFS projects has a significant positive effect on selection of communicative information.

The second central research question focuses on whether participation of emergency responders in planning projects affects selection of communicative information. Hypothesis 2 posits a significant negative relationship between emergency responder participation in planning projects and communicative information selection. Hypothesis 2 is not supported in this research. There is not a significant negative relationship between HazMat responder participation in HMCFS projects and communicative information selection. It is expected this hypothesis would be demonstrated with more robust measures of communicative information selection in planning organizations than was possible using the available variables for this research. It also appears that HazMat responders may function as information channels to domain-specific sources of communicative information—interviews with local emergency responders.

The third central research question focuses on whether increasing participant diversity leads to increasing selection of diverse information sources in planning projects. Hypothesis 3 posits a significant positive relationship between planning participant diversity and information selection diversity. There is significant statistical

evidence in the research sample to support Hypothesis 3—increasing participant diversity in HMCFS projects has a significant positive effect on selection of diverse information sources, both in terms of the number of selected HMCFS information sources, and the number of selected HMCFS information types.

Four related questions have bearing on the objective of this research for informing planning theory, practice, policy, and guidance and addressing associated gaps in the literature. The first of these questions asks whether constructs of significant planning theories such as communicative rationality are applicable to specific aspects of the planning process such as information selection, and in domains such as emergency planning. The results of this research provide evidence that constructs of communicative rationality are applicable to information selection in emergency planning. Nearly half of the informants in the research sample indicate that communicative information was selected in their LEPCs' HMCFS projects.

The second related research question asks whether selection of communicative information sources is affected by the types of participants in the planning process. The results of this research indicate that different types of planning participants have different effects on communicative information selection. Community planner participation in HMCFS projects has significant positive effects on selection of communicative information. Participation of HazMat responders does not have significant negative effects on communicative information selection. However, the measure of HazMat responder participation in HMCFS projects has significant positive correlations with a component of communicative information selection, interviews with

local emergency responders. This suggests that HazMat responders may satisfice in information selection by primarily engaging information sources that are most accessible to them, but in doing so they function as potentially important channels to domain-specific communicative information sources.

The third related research question asks whether institutional values and norms of planning participants and their associated temperaments affect strategic choices in planning processes, and correspondingly, whether guidance and legislation regarding emergency planning participants is sufficiently defined and inclusive of community planners. The socio-cultural framework of this research identifies that community planning as an organizational and professional institution has norms and values that facilitate selection of communicative information in HMCFS projects. Emergency response as an organizational and professional institution has norms, values, and temperaments of its members that do not appear to facilitate selection of a broad range of different information sources, but emergency responders do function as channels to domain-specific information.

Community planners are not considered key members of emergency planning processes in primary federal emergency planning guidance and legislation, although they are recognized as having key roles in secondary emergency planning guidance, such as recommendations for natural hazard mitigation and hazardous materials commodity flow studies. The results of this research suggest that federal planning guidance and legislation should be strengthened to include community planners as key members of

public planning processes, regardless of the particular domains in which the process is applied.

The fourth related research question asks whether the planning process, including information selection, benefits from participatory planning. This research suggests that participatory planning can be beneficial. There is evidence that diversity of HMCFS participants has a positive effect on HMCFS information selection diversity. Specific types of planning participants do appear to have positive effects on selection of specific information types as a result of their institutional norms and values and their know-how through education, training, and experience. Other types of participants benefit the planning process by functioning as channels to information sources.

This research does not evaluate the degree to which participation promotes selection of communicative information from a diverse range of community stakeholders, only from emergency responders, industry, and transport carriers, who are powerful stakeholders in emergency planning. However, planning participation for participation's sake may be ill-advised for improving information selection in the planning process. Rather, planning organizations would be advised to carefully consider who should be involved and what they bring to the table relative to planning goals and objectives. Further research is needed to strengthen these results and recommendations.

Finally, this research contributes to planning theory and practice by exploring how communicative and participatory behavior in planning information selection can also be explained using four types of descriptive rationalities. These include institutional/contextual rationality, bounded rationality, instrumental rationality, and

political rationality. The role of these rationalities and their underlying constructs is explained through relationship pathways between information selection, planning participants, planning organizations, and communities and regions. Specific recommendations for improving emergency planning practice are identified. Four prescriptive recommendations for planning theory and practice are explicated. These recommendations are that planning should be:

- institutionally-professional;

- maximizing/optimizing;

- instrumentally-adaptive; and

- proactive/responsive.

Specific recommendations are identified that relate significant research observations with prescriptions for planning theory and practice.

This research helps address significant gaps in the literature and empirical evidence about communicative planning, planning information, and applicability of planning theories to emergency planning practice. In addressing these gaps, this research uses evidence which grounds this research in a real planning environment, focuses this research on what planning organizations do, and informs the research by actual planning practices (Krizek, Forsyth, & Shively Slotterback, 2009). While doing so, this research uses theoretical constructs that help identify key issues, predict their effects, measure research outcomes, generalize results to other settings, and develop treatments to enhance planning practice (Webler & Tuler, 2002).

The outcomes of this research are not especially surprising. However, the importance of this research lies not in novelty of the outcomes, but its importance is rather based on empirical evidence across a sample of U.S. planning organizations using quantitative, multivariate analysis. Through its extension of theory to planning practice in general and to a venue of practice that is not traditionally considered in planning studies (emergency planning), this research contributes to the overall field of planning knowledge. The outcomes and proposed framework speak to the theory of planning in multiple ways. They are relevant to planning processes, they explain planning practices, and they can be used to guide planning and decision making. They also speak to the practices of planners and planning by recognizing the contributions that planners and other planning stakeholders make to the planning process in different venues, and by describing ways in which community planning processes are effective and can be improved.

7.2 Limitations of Study

This study has several limitations that are important to recognize. First, the sampling of the study limits the generalizability of the results. As described in Section 4.3, surveys were distributed to the population that was generally complete in 36 Continental U.S. states, while the distribution to the population in 12 Continental U.S. states was unknown because contact information was largely incomplete, and the researchers relied on state emergency response commissions to distribute the survey to LEPCs on their behalf. Responses were received from LEPCs in only 6 of these 12 states.

As described in Section 6.2.1, there are very good reasons to expect that the research sample consists of responses from LEPCs that are more proactive than their peers given the nature of LEPC organizations and HMCFS projects, and the fact that survey informants were self-selected. However, the results of this research are presented in light of the greater likelihood that they reflect the behaviors of active, engaged planning organizations and other local planning consortiums, which are the types of entities that would be expected to use planning information, rather than inactive, disinterested planning organizations. Although the generalizability of this research to all LEPCs is limited by the sampling and response framework, it is generalizable to LEPCs, emergency planning agencies, and planning consortiums that are actively engaged. Thus, the sample is representative of a population whose behaviors can better inform and be informed by planning theory and practice.

Other important limitations result from using secondary data that were intended to inform different type of questions about LEPC practices—what are best practices in LEPC conduct of HMCFS. Good social science recognizes limitations of imperfect data and measures (Blau, 2007, cited with permission), and in this study the use of secondary data limits the author's ability to evaluate planning participation and information selection measures with variables that might be better suited to the research questions and methods. Table 1 lists a wide range of potential measures that might be used to measure aspects of participation in planning processes. Some basic measures of participation were able to be included for this research, but others might be considered as well in further studies. For example, direct measures of the phases or steps in the

process at which participation is used, experience of planning staff with participatory techniques, knowledge and skills of participants in using information, level of coordination among participants in the planning process, objectives of planning participants, and implementation of participatory planning outcomes are just a few of the many potentially interesting measures of participation that could be applied to information selection in planning organizations.

For communicative information selection, reliance on three-level ordinal scales as dependent variables in linear regression models resulted in heteroscedasticity of regression residuals and created a significant potential for error if responses were incorrectly specified. This limitation is considered in light of 'collective cognitive structure' that informants drew upon in describing the actual activity that occurred. This limitation was also addressed by using binary logistic regression as a second method of evaluating information selection behavior. Although informants might have been less likely to recall the exact sources of information that were selected, it is likely they could recall whether or not any communicative information sources were selected. The use of two different methods to evaluate related measures of information selection behavior thus provides a conservative approach. For the most part, the significance of regression coefficients was consistent for both forms of the communicative information selection dependent variable—the majority of variables that were significant in linear regression models were also significant in binomial logistic regression models, with exceptions as noted in discussion of the results.

The number of variables in regression models and significance criteria are other

limitations that should be considered. Review of the literature suggested a variety of

measures that influence local planning and decision-making at community and regional,

organizational, project, and participant levels. Contextual variables were retained in

regression models at two-tailed significance levels of $p \leq 0.10$. This creates an

opportunity—one in ten—that spurious relationships are exhibited for some of the

contextual variables that were retained in regression models. However, it is inherently

conservative for the independent variables that are of primary interest. By retaining a

greater number of contextual variables and using a sequentially ordered regression

approach, the portion of variance associated with contextual variables that was partialed

and unavailable for the independent variables was greater than it would have been if

more-restrictive significance criteria were used. This makes significance of independent

variables more robust and less likely to reflect spurious relationships.

Another limitation is that the author's interpretation of theoretical constructs and

variables associated with different measures might not be correct or might be

inappropriate for the setting and context of this research. Although variables were

selected from the available data which represent theoretical constructs that are identified

in extant literature, it is possible that these other variables might be used to represent the

measures that were included in this research. This is an area for further research. These

limitations are considered in light of the general correspondence of research results with

other research. Constructs that appear to be especially important in this research—

norms, values, and temperaments, satisficing, information channels, vicarious

experience, know-how, known/perceived risk, community needs, and perceived task complexity—are important in extant empirical literature.

This research is interpreted not just in light of empirical relationships, conceptual associations, and the literature, but through the lens of the author's experience as well. This experience includes in-depth work with the source dataset from which the research sample was derived, participation as co-lead investigator on a project team that developed a research report and guidebook about conduct of HMCFS, and conduct of 15 HMCFS projects with another practitioner from 2008-2011 for LEPCs in Texas covering roadway, railway, pipeline, and waterway modes of transport. This experience may help strengthen confidence in the interpretation of research outcomes.

Another limitation of this research is its ability to account for variance in the measures of planning information selection using the specific measures and variables that were included in the regression models. Only a low to medium amount of variance in level of information selection was explained. This suggests that there are other important measures that need to be considered to fully explain information selection in HMCFS projects. A related limitation is that only main effects with the dependent variable were evaluated, albeit in a sequential manner. While more-distal variables are interpreted as acting through more-proximal variables, it is likely that some variables are actually interacting, and effects of those variables may be attenuated or not identified altogether using only main effects models. Addressing this limitation would benefit from careful assessment of variables that are likely to interact, and a more-extensive data set in terms of number of cases.

Finally, a greater number of valid cases would help address another potential limitation of the study, its power to conclude that relationships that do not appear to be significant are in fact not significant. The initial sample identified 280 LEPCs that indicated they had conducted HMCFS projects. Failure of some informants to answer key survey questions, or their indicated level of uncertainty or lack of involvement in the projects, resulted in exclusion of 97 cases. While this increases confidence in the validity of responses that were retained in the research sample, it reduces the number of cases to 183. Listwise exclusion of cases that have missing data for contextual variables further reduced number of cases in final regression models by around 15-20 percent (imputation of missing data with mean values did not substantially change regression outcomes, and explained a smaller proportion of variance). Although a power analysis was not specifically performed for this study, the use of a less-restrictive two-tailed significance criterion of $p \leq 0.10$ for contextual variables gives greater confidence in the power of the analyses. A greater number of cases could improve that confidence.

7.3 Future Research

A wide range of related future research topics could be beneficial to planning research and practice. Such topics could be focused narrowly on information use in emergency planning projects such as HMCFSs in LEPCs. For example, further research might use related data from the research sample about the *importance* of different types of information for emergency planning outcomes. As alluded to previously, other studies might focus on better and broader specification of the different types of information and participants. Such studies might capture other potentially important

measures, such as characteristics and perspectives of alternate planning participants and organizations than were considered in this study. This could enable an accounting of individual perspectives and temperaments, and further illuminate how institutional norms and values influence information and decision-making preferences. Future research might follow the planning process over time, examining how information perceptions change as information is collected, used, and implemented to generate knowledge and alternatives. Studies could further examine how local perceptions and knowledge of risk influence the emergency planning process, or evaluate the roles that information plays in different aspects of emergency planning.

More broadly, future research could extend planning theory and practice to other types of information and settings. For example, this study examined applicability of communicative and participatory theory constructs locally-sourced communicative information, but other types of information such as technical, non-local, and prior-studies information could be examined as well. Future research could also examine ways that a broader range of planning theory constructs (e.g., advocacy, incrementalism, etc.) map to the four descriptive rationalities discussed in this research, or whether other descriptive rationalities are evident. Such studies could also evaluate whether the recommendations for planning theory and practice identified in this research are complete, valid, and appropriate prescriptions for other aspects of the planning process, and/or in other planning venues. Future studies might identify relationships and associated constructs between information selection and participation in other venues,

not just traditional planning domains such as land use, environmental, or transportation planning.

The breadth of future research topics is potentially endless. This study focuses on a specific part of the planning process in a specific setting, and in doing so explores application of planning theory to planning practice. Results demonstrate that interesting, relevant, and potentially valuable outcomes can result from research that builds bridges between theory and practice.

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APPENDIX A. RESEARCH SETTING

A.1 Hazardous Materials Transportation

Every day, massive quantities of hazardous materials (HazMat)—explosives, gases, flammable liquids, flammable solids, oxidizers and organic peroxides, toxic materials and infectious substances, radioactive materials, corrosive materials, and miscellaneous dangerous goods—are produced, used, stored, and moved in the U.S. and internationally. The hazard exposure to local communities is substantial, even in rural areas. Data from the U.S. Environmental Protection Agency (EPA) indicates there were over 13,200 U.S. chemical facilities in 2005 with vulnerable zones that included at least one off-site community resident, 600 of which reported vulnerable zones impacting populations of 100,000 or more (Schierow, 2006). As might be expected, many facilities are associated with energy production, petroleum refineries, and petrochemical production. However, data analyzed from EPA's RMP*Info database indicates that between 1994 and 1999, the top four most frequently reported industry classification codes for chemical facilities were farm supplies wholesalers, water supply and irrigation systems, sewage treatment facilities, and refrigerated warehousing and storage facilities, which combined comprise over half of the facilities in the database (Kleindorfer, Feldman, & Lowe, 2000). Hazardous materials that are not produced, consumed, or disposed of at these facilities are transported to other locations primarily by road, rail, pipeline, and waterway.

In 2007, over 2.2 billion tons of HazMat were moved over U.S. roadways, railways, pipelines, and waterways, and over half of the tonnage was moved by trucks (Duych, Ford, & Sanjani, 2011). Most HazMat shipments in the U.S. reach their destinations safe and secure. However, around 50,000 HazMat transport incidents per year, or two per hour, are reported annually to U.S. DOT incident reports databases by private carriers (G. O. Rogers, et al., 2010). This is likely a conservative estimate since there is a substantial amount of underreporting of HazMat transport incidents to federal incident reports databases by private carriers (Battelle Memorial Institute, 2009). In an analysis by the Pipeline and Hazardous Materials Administration (PHMSA) of the U.S. Department of Transportation (DOT), of over 87,213 transport incidents and 377 associated casualties that occurred between 2005 and 2009, highways accounted for nearly 65 percent of high impact casualties (HICs), and railways for nearly 27 percent of HICs when weighted by impact (PHMSA, 2011b). Because most U.S. communities are developed around and heavily dependent on highway access, this creates a prevalent local risk. A recent survey of hospital administrators identified hazardous materials as the threat perceived to be most ubiquitous of all man-made or natural hazards in U.S. communities (Braun, et al., 2006).

A.2 Local Emergency Planning Committees

The Emergency Planning and Community Right-to-know Act (EPCRA) was passed by Congress in 1986 in response to the 1984 Union Carbide chemical disaster in Bhopal, India, and a near-disaster for a similar Union Carbide chemical facility the following year in West Virginia. EPCRA mandated the formation of local emergency

planning committees (LEPCs), which are local-level organizations that are responsible for local chemical hazards planning and enabling community right-to-know. Clearly LEPCs must account for a lot of hazards and risks. Yet, when Congress established the mandate for LEPCs under EPCRA, it established them as volunteer, multi-stakeholder organizations and failed to provide federal funding mechanisms for LEPC operations—that is, LEPCs are largely an unfunded mandate. Many LEPCs receive at nominal financial support through local governments and local industries. A small minority of LEPCs even receive substantial levels of non-federal funding through industry membership contributions or means. Some federal funds are available to LEPCs, such as U.S. DOT's Hazardous Materials Emergency Preparedness (HMEP) Grant Program, distributed by state coordinators to LEPCs for conducting HazMat training and planning (tribes and other entities also receive HMEP funds). However, most LEPC resources (funds, facilities, time, personnel), are donated by their local constituencies. Leadership and active membership in most LEPCs is comprised of local emergency management, emergency response, local elected officials, industry, and public health officials as a function of their paid roles in community leadership. Nearly all LEPCs report that lack of funding, time, or personnel resources are barriers for their organizations (G. O. Rogers, et al., 2010).

A substantial minority of the more than 4,100 LEPCs in the U.S. are functionally inactive, particularly in rural jurisdictions (Starik, et al., 2000). However, LEPC inactivity does not mitigate the presence of risk due to chemical hazards transport in such communities through highway, rail, pipeline, and waterway transport routes. Of

active LEPCs, many meet in small groups quarterly or biennially, and many LEPCs fail

to have the membership representation required under EPCRA (Starik, et al., 2000).

Other LEPCs are much more engaged, receiving broad community interest and

membership, meeting monthly or even more frequently.

A.3 LEPCs and Planning Participation

LEPCs were established with mandates of broad community membership under

EPCRA. LEPC membership is supposed to include:

- "Elected State and local officials;

- Law enforcement, civil defense, firefighting, first aid, health, local
  environmental, hospital, and transportation personnel;

- broadcast and print media;

- Community groups;

- Owners and operators of facilities subject to the requirements of
  [EPCRA]" (Emergency Planning and Community Right-To-Know Act,
  1986)

Figure A.1 (original) illustrates the statutory minimum requirements for LEPC

membership and leadership structure, patterned after Bates and Harvey (Bates & Harvey,

1986; Peacock, 1991). In practice, LEPC membership consists mainly of government

officials, emergency responders, and industry stakeholders (EPA, 2009b; Rich, et al.,

1993) but can also include other stakeholders. Figure A.2 (original) illustrates a

hypothetical LEPC structure that includes LEPC executive leadership, a formal

subcommittee, and an ad-hoc subcommittee. Well-organized LEPCs may have multiple

subcommittees that deal with issues such as training, mass care, evacuation, or other issues of relevance to the organization. Some stakeholders have multiple roles in the LEPC (for example, by serving on multiple committees), some are represented on LEPC only, and some are not represented in any LEPC functions. In addition, other entities that are not designated in EPCRA for minimum LEPC membership requirements may also be part of the LEPC.

While LEPCs are multi-jurisdictional, 'quasi-governmental,' volunteer, not-for-profit organizations, administrative functions in some LEPCs may be assumed as part of the job responsibilities of paid, professional officials or community members. However, Whitney and Lindell (2000) note that paid agency or business personnel who serve on LEPCs typically do so in an unpaid capacity outside of their normal jobs. Most LEPCs have very limited budgets or ability to support permanent staff (Rich, et al., 1993). This means that LEPCs are under substantial time and resource constraints, increasing the importance of the voluntary and participatory nature of the organization. The role of LEPCs can be expected to fall between 'action collaboratives' and 'organizational collaboratives' in Margerum's typology of collaborative planning organizations (Margerum, 2008)

LOCAL EMERGENCY PLANNING COMMITTEE MINIMUM STATUTORY MEMBERSHIP

ELECTED LEADERS
- Elected State officials
- Elected local officials

AGENCY PERSONNEL
- Law enforcement
- Civil defense
- Firefighting
- First aid
- Health
- Local environmental
- Hospital
- Transportation

LOCAL EMERGENCY PLANNING COMMITTEE

Includes Chairperson and Information Coordinator

MEDIA
- Broadcast media
- Print media

COMMUNITY GROUPS

EPCRA FACILITIES

42 U.S.C., Chapter 116, Subchapter I, § 11001 (c) *Establishment of local emergency planning committees* Not later than 30 days after designation of emergency planning districts or 10 months after October 17, 1986, whichever is earlier, the State emergency response commission shall appoint members of a local emergency planning committee for each emergency planning district. Each committee shall include, at a minimum, representatives from each of the following groups or organizations: elected State and local officials; law enforcement, civil defense, firefighting, first aid, health, local environmental, hospital, and transportation personnel; broadcast and print media; community groups; and owners and operators of facilities subject to the requirements of this subchapter. Such committee shall appoint a chairperson and ... include the designation of an official to serve as coordinator for information.

Figure A.1. Statutory requirements for LEPC membership.
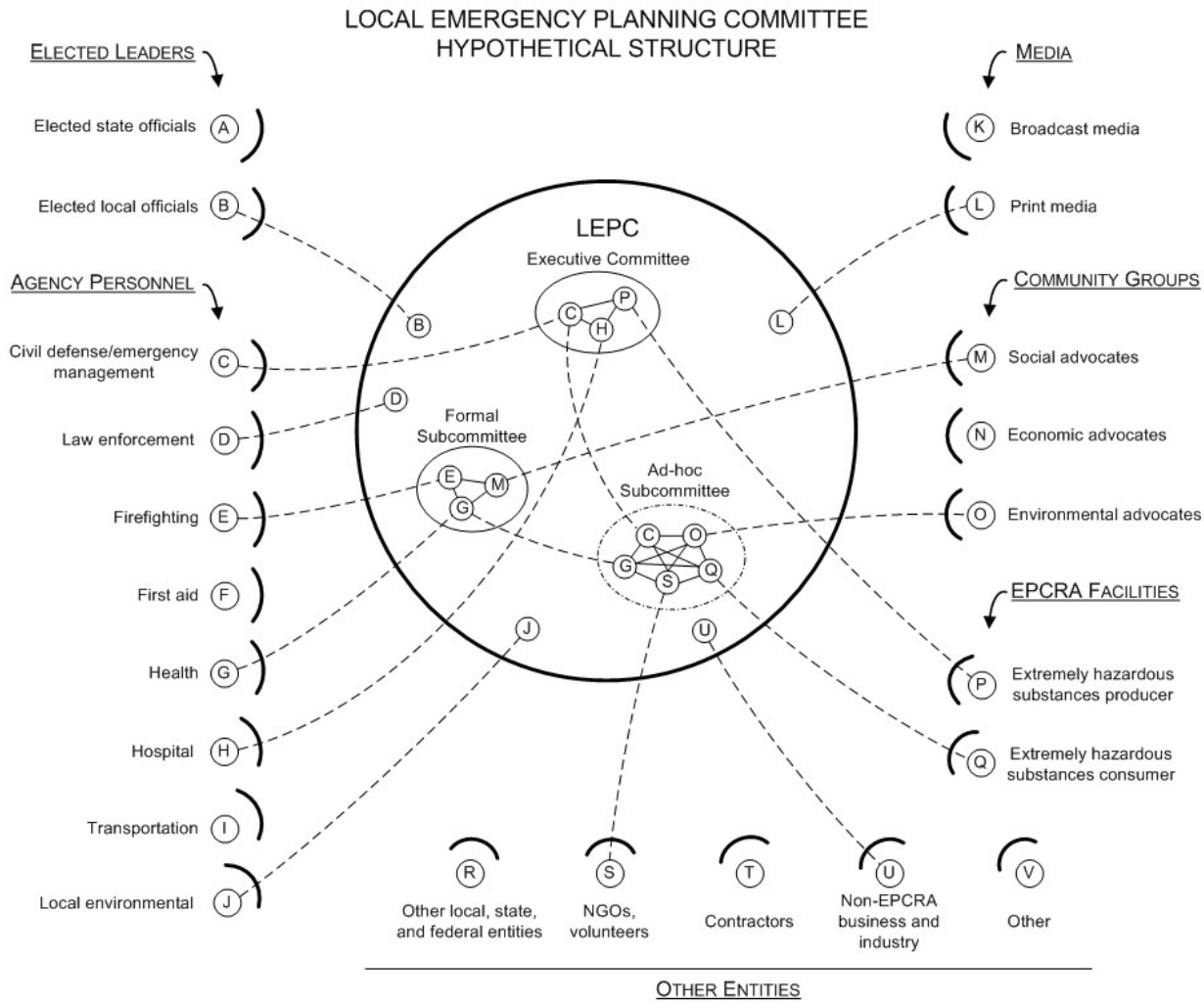
Figure A.2. Hypothetical LEPC organizational structure.

A.4 HazMat Commodity Flow Studies

LEPCs are designated by federal legislation with responsibility for local chemical hazards planning, including annual plan updates and enabling community right-to-know. One of the components of required emergency plans is an assessment of the routes in the LEPC's jurisdiction by which HazMat is transported, but the means by which this is accomplished are not specified. A hazardous materials commodity flow study (HMCFS) describes hazardous materials movements over transportation networks into, out of, within, and through an area (ICF Inc., 1995; G. O. Rogers, et al., 2010). An HMCFS is primarily focused on collection and interpretation of information, which can be used to provide 'environmental cues' about the nature of technological hazards due to transportation of hazardous materials in a community (Lindell & Perry, 2004). HMCFS are not a mandatory component of local chemical hazard plans. However, Rogers et al. (2010) identified that HMCFS information supports a variety of different emergency and community planning objectives, including:

- Defining training scenarios for HazMat incident responders;

- Planning for emergency procedures such as shelter-in-place and evacuation planning;

- Informing comprehensive community planning such as siting of transport routes, gathering places, or critical infrastructures;

- Identifying HazMat incident response equipment needs;

- Allocating staff, equipment, and other resources in terms of locations and schedules;

- Designating or restricting routes over which HazMat may be transported; and

- Supporting legal takings.

A review of predominant HMCFS guidance documents is presented in the following paragraphs and sections, and identifies sources of existing and new information and data specific to these projects.

The U.S. DOT's 1995 *Guidance for Conducting Hazardous Materials Flow Surveys* (ICF, 1995), hereafter referred to as U.S. DOT's *Guidance*, was historically and currently remains a primary source of specific instruction available to LEPCs for conducting a hazardous materials commodity flow study. Linkages to the document are provided in PHMSA's on-line library of HazMat transportation-related documents. Two other guidance sources are also available on-line: EPA's 1993 *Hazards Analysis on the Move* (EPA, 1993), hereafter referred to as EPA's *Hazards Analysis*, and instructions and presentations about commodity flow studies from TRANSCAER™, a chemical manufacturer and transport carrier association are also available (TRANSCAER, 2011) and are hereafter referred to as the *TRANSCAER Manual*. Although all three documents are available on the Internet, with U.S. DOT's *Guidance* likely receives the greatest exposure by far for LEPCs since information about the document linked by the primary source that LEPCs use for HMCFS funding, U.S. DOT's HMEP grants. Table A.1 summarizes the sources of HMCFS data as described in each guidance document. Note that an update to the U.S. DOT *Guidance* was published and made available on-line by the Transportation Research Board in August 2011 (Bierling, et al., 2011), but as of

December 2011 this document has not yet been linked to reference materials made available though PHMSA's on-line library or the HMEP Grant Program Web site. This document was also unavailable at the time of the survey (2008) from which the data sample for this research was drawn.

Data sources for an HMCFS include:

- Secondary (previously existing) technical information from local agencies, industry, or carriers and incident/accident data (may also include elements of shipping manifest surveys).

- Original (new) technical information such as traffic and placard counts.

- Communicative information from experts such as that obtained from interviews with emergency responders, transportation carriers, and facilities (may also include elements of shipping manifest surveys).

- Prior HMCFS studies conducted by the LEPC or other jurisdictions.

- Non-local information such as data from federal and state agencies, technical guidance documents, and other information obtained from the Internet.

Table A.1. Sources of data described in HMCFS guidance documents.

Document	HMCFS Data Sources	

U.S. DOT *Guidance for Conducting Hazardous Materials Flow Surveys*	Maps, atlases, and local knowledge of roads
	
	Federal data (U.S. DOT Highway Performance Monitoring System, U.S. Bureau of Census Commodity Transportation Survey (BTS Commodity Flow Survey) and Truck Inventory and Use Survey)
	
	Technical guidance from FHWA
	
	Accident records: U.S. DOT PHMSA Hazardous Materials Incident Reporting System (HMIS); U.S. DOT FHWA Office of Motor Carriers Safety Net and other U.S. DOT data; newspaper files; state and local police reports; NTSB, DOE)
	
	State agencies: DOT; environmental protection; state and local health departments; economic development agencies; turnpike authorities
	
	LEPCs and other planning groups
	
	Existing studies; studies from other jurisdictions
	
	Data provided through TRANSCAER
	    • Substances that originate and terminate locally
	    • Quantities stored locally
	
	SARA Title III facility reports
	
	Industry and private associations (trucking, chemical distributors, carriers, petroleum and chemical manufacturers, transportation infrastructure)
	    Interviews with local emergency responders
	
	Facility survey for precise shipping data
	    • Can be polled for trends, exact mode/route, hours and days of week for shipping/receiving
	    • Follow up may be needed for clarification and increase response
		Roadside traffic survey – days or weeks
		    • Date and time sample record was taken
		    • Truck type
		    • Cargo type
		    • DOT placard
		    • Four digit UN/NA ID #
		    • Tank or trailer rated capacity
		
		Shipping papers
		    • Any routing instructions
		    • Four digit UN/NA commodity ID #
		    • Destination of shipment (city and state)
		    • Four digit STCC code number
		    • DOT shipping name
		    • Quantity of lading (weight or volume)
		    • Origin of shipment (city and state)
		
		Driver interviews
		    • Company
		    • Route
		    • Destination (in-state/out-of-state)
		    • Familiarity with material
		    • Safety training	

Table A.1 continued. Sources of data described in HMCFS guidance documents.

Document	HMCFS Data Sources	
EPA *Hazards Analysis on the Move*	Local, state, industry maps	Pipeline companies and utility commissions
	Federal and state agencies (including state DOT)	Shipping companies
	U.S. Coast Guard and U.S. Army Corps of Engineers for Waterways	Industry associations (chemical manufacturers, railroads, trucking)
	Accident records: Federal and state agencies, U.S. DOT HMIS incident database, State DOT, police, hospitals, media, State EMA, public health, industry	Police and other emergency responders for roads and intersections where accidents have occurred
	Technical guidance documents (from U.S. DOT, EPA, FEMA, TRANSCAER, Institute for Transportation Engineers)	Questionnaires for fixed facilities
		• Amounts
	Metropolitan Planning Organizations	• Modes
	Nearby municipalities	• Hours/days of shipping/receiving
	Ongoing data collection programs (local fire departments)	• Major carriers
		• Most frequent origins and destinations
	Facility Tier II chemicals storage reports	• Often require follow-up for clarification and increase response
	• Fixed facility representative may provide rough estimates of material types and quantities	Traffic counts; roadside placard survey – days or weeks
	• EPCRA provides tools to obtain information from other fixed facilities	• *Observers note the number of trucks that pass by, their placards, the time, and the type of container used* (p. 8).
	Transportation depots: truck, seaport, airport, rail	• Roadside or weigh station manifest survey
	Shipping waybills and manifests: railroads, power plants, manufacturing facilities, waste management, public facilities	• Guidance notes that roadside placard surveys and manifest surveys can generate large amounts of data
TRANSCAER™ Web Pages	Local maps	Identify major highways, major airports, and all navigable waterways
	Fixed facilities plans for chemical IDs, amounts, and routes for in-bound and out-bound materials	Review major accident information
	Request listings of chemicals, amounts, and frequencies from identified railroads	Technical guidance reference to EPA *Hazards Analysis on the Move* and DOT *Guidance for Conducting Hazardous Materials Flow Surveys*
	Request listings of products, amounts, flow rates, pressure, seasonal cycles, and booster/injection stations from identified pipelines	

A.4.1 Secondary technical information

The first type of data that can be identified from HMCFS guidance documents are data provided by local industry/fixed facilities and HazMat incident/accident data which imply a dimension of secondary (previously existing) technical (quantitative) information. In this case the information user must have access to the source of previously compiled (existing) data, and that source must provide the data to the information user. These data likely have a very strong local component: data users will likely have greater access to local transport carriers than non-local transport carriers. They may also have local access to incident/accident data, and many nonlocal HazMat incident or accident data sources can be queried for specific areas such as individual local jurisdictions. Provision of data by one entity to another implies an element of control by the provider over the type, amount, and nature of information that are released, even considering legal requirements. Users must evaluate the data for meaning to its application, but they do not have to collect original (new) data. Shipping paper or manifest data is also technical information that might be considered in this category.

A.4.2 Original technical information

The second type of data that can be identified from HMCFS guidance documents are placard counts and vehicle/vessel type counts which imply the collection of data through traffic surveys. They indicate a dimension of local, original (new) technical information. Although conceptually similar, these two types of traffic surveys are different. A vehicle/vessel type count is based on observations of vehicles and storage vessels used in commercial transportation, but does not imply recorded observation of

material hazards transported by vehicles. A placard count is based on observations of
hazardous materials placards which informs about the nature of the hazard being
transported, but does not imply recorded observation of the vehicles by which those
hazards are or are not transported. They may be conducted independently (one or the
other) or concurrently. Information users have control over the type, amount, and nature
of data that are collected, but they must expend effort (which may be considerable) for
data collection, reduction, and analysis.

A.4.3 Communicative information

The third type of data that can be identified from HMCFS guidance documents
are interviews with subject matter experts, which indicate a dimension of communicative
information that is obtained through interview or survey processes. As with existing
technical information, these data have a strong local component: data users will likely
have greater access to local representatives from emergency response agencies, transport
carriers, and industry representatives than non-local representatives. Presumably, these
interviews would result in a different, more subjective type of information than would be
obtained simply from an examination of raw data. Importantly, the direct
communication provided by an interview might result in questions or topics of
discussion that interview participants do not have control over and/or may not be
comfortable with. Effort must be expended to conduct interviews and compile interview
information, and both personal and organizational communication barriers must be
overcome. Since interviews with industry and transport carriers may be conducted in
association with collection of shipping paper or manifest data, this activity also has

elements that may be considered in this category, although review of shipping papers itself is a more technical activity. Communicative information from lay people is not a suggested source of information in any of the HMCFS-specific guidance documents that were available at the time of the survey (2008) which is the data source for this research.

A.4.4 Previous studies

The fourth type of data that can be identified from HMCFS guidance documents are previous studies, an existing source of HMCFS information. Previous HMCFS or other traffic studies conducted for the jurisdiction can provide an indication of priority data collection locations and important contacts. They also provide a baseline against which new HMCFS information can be compared to identify whether traffic patterns and risks have changed over time. Previous HMCFS studies provided by other jurisdictions along common transport corridors may also provide indications of traffic patterns or types which may be expected, since traffic patterns over major corridors such as Interstate highways tend to change little from county to county, especially in rural areas with no major diversion points between such as major cities or interactions with other national highways. Previous studies for the jurisdiction or other jurisdictions can also provide an indication of data collection methods that were used. This can be positive or negative, depending on whether the methods were appropriate to the data that were collected.

A.4.5 Non-local information

The fifth type of data that can be identified from HMCFS guidance documents are data provided by federal or state agencies (and Internet sources today), which imply

a dimension of non-local information. These data sources summarize national or state level statistics, trends, and patterns that are not directly applicable to local situations. They may also consist of technical guidance about HazMat transportation or response, or collection and documentation of transport data, such as guidance documents for conducting commodity flow surveys. Interestingly, the U.S. DOT *Guidance* describes in its only local-level case study for Dallas, Texas (the remaining case studies were at the state level) that "[l]ittle of [the information from federal, state, and local agencies] was useful due to the regulatory and reporting framework within which it was collected, therefore, Dallas decided to conduct its own data collection activities" (p. 32). This is similar to results from Starik et al. (2000) on usefulness of different technical information and assistance resources as rated by LEPCs. A review of their survey results indicates that the CAMEO emergency operations software and ALOHA air modeling software—both federal risk analysis tools, had the highest percentages of LEPCs rating them as 'very useful,' the highest level in the survey scale. However, seven out of the next eight technical resources rated as very useful by LEPCs were either at the local or state levels. In contrast, all ten of the technical resources rated by LEPCS as 'don't know; not familiar' were either national or federal conferences or federal software programs other than CAMEO or ALOHA.

A.5 Summary of HazMat Transport, LEPC, and HMCFS Literature

LEPCs are local organizations that are mandated by federal legislation and charged with conducting planning for chemical hazards and enabling community right-to-know about chemical hazards. The large majority of LEPCs are all-volunteer

organizations, and most receive little-or-no direct funding unless it is awarded through grants, such as U.S. DOT's Hazardous Materials Emergency Preparedness (HMEP) Grants, or through industry contributions or membership "dues." As a result, most LEPCs are highly constrained in terms of external resources.

Federal legislation designates and federal guidance recommends that LEPC membership be made up of certain and diverse groups. Active LEPC members are often the same key stakeholders from emergency planning practice in general—officials or staff from emergency management, public safety (fire and law enforcement), health, industry, or other locally prominent organizations. Elected state officials, media, environmental groups, and community groups tend to have lower representation on LEPCs. As a result, many LEPCs are constrained in terms of internal resources. Planning professionals—community planners—are not included in the federal membership requirements for LEPCs, but this does not exclude them from being LEPC members or participating in it.

While LEPCs are charged with providing for community right-to-know, many face structural, political, and operational barriers in doing so. Despite the collaborative and participatory concept of LEPCs in their enabling legislation, there are several factors that make public participation in LEPCs prohibitive in practice. It thus becomes especially important that the public be represented by entities that can effectively represent their interests and advocate on their behalf.

In spite of these challenges there are a wide range of activities that LEPCs can undertake in fulfilling their missions. This includes chemical hazards planning,

including hazard, vulnerability, and risk assessments. A hazardous materials commodity flow study is a type of planning project that can inform all of these activities, making it a potentially important resource for local planning and decision-making.

The basic function of an HMCFS is to identify the types, quantities, and patterns of hazardous materials moving over a community's transportation routes. The primary goal of an HMCFS is to provide hazardous materials transportation information that can be used for other subsequent applications. HMCFS objectives include describing the types, amounts, quantities, and patterns of hazardous material transport, where they are transported, associated transport requirements, and increasing awareness for transport carriers and emergency responders. A wide range of other participants can assist with conducting an HMCFS, including LEPC members and non-members.

APPENDIX B. SURVEY INSTRUMENT

2008 Survey of LEPCs about HMCFS

Note: The formatting of the following survey questions have been modified from that presented in online version administered through software by Qualtrics, Inc. The content of survey questions is retained, and represented as follows:

- Questions with text response fields are represented by a small box next to or below response options for limited text responses, and a larger box below response options for short-answer responses.
- Questions presented with drop-down list of potential responses for which only one response could be selected are represented by a list of responses options below the question, and have the text "Select from drop-down list" or similar in the question text.
- Questions presented with a list of potential responses for which only one response could be selected are represented by a response list or row with associated radial dials next to the response options.
- Questions presented with a list of potential responses for which multiple responses could be selected are represented by a response list with associated check box next to response options.
- Questions presented with potential responses in a table of radial dials allowed the informant to select one option among multiple columns for each row.
- Questions presented with a table for which informants could provide text for multiple columns for each row are presented represented by a tabular format with boxes for limited text responses.

Hazardous Materials Commodity Flow Surveys:
Understanding, Practices, Barriers, and Incentives

Project HM-01:
Hazardous Materials Commodity Flow Data and Analysis

Conducted for:

Transportation Research Board
Hazardous Materials Cooperative Research Program

Conducted by:

Texas A&M University
Hazard Reduction & Recovery Center

and

Texas Transportation Institute
Multimodal Freight Transportation Programs

Texas Transportation Institute and Texas A&M University are working on a project for the Transportation Research Board (TRB) to update the Guidance for Conducting Hazardous Materials Flow Surveys, published by US DOT in 1995.

Your participation in a survey about hazmat commodity flow surveys -- even if you have never conducted one or your Local Emergency Response Committee (LEPC) is not currently active -- will be very helpful for this effort. The survey will take between 10 and 30 minutes, depending on your experiences in this area. Thank you in advance for this substantial time commitment.

Your responses will help us produce a better guidebook that can be used by local, state, and tribal emergency planners and responders.

Your participation in the survey is voluntary. Should you have any questions about the survey, please contact Dr. George Rogers at (979) 845-7284 or Mr. David Bierling at (979) 862-2710. Should you have any questions about your rights as a research volunteer, please contact Melissa McIlheny, Texas A&M Institutional Review Board, at (979) 458-4067.
Thank you very much for your assistance!

We respect the privacy of your survey response and contact information. We will use these data as whole and not publish any identifiable information without specifically asking you. Because we have not required a login/password, your survey response will not register specific agencies/persons/locations, unless you provide it through the entry form below.

If you can provide the following contact information, it is very helpful for a number of reasons:

1) It helps us identify what kind of jurisdictions are responding, from where, and who to contact should the need arise.
2) It also keeps us informed regarding your response so that we can avoid bothering you with follow-up requests for participation.
If you'd rather not provide this information, we understand, and please advance to the next question...thank you!

LEPC/TERC jurisdiction/agency name

(if you are responding for multiple LEPCs, please list all of them)

State (if not applicable, enter 'NA')

Your name (first and last)

Your e-mail address

Your phone number

Your function in LEPC/TERC

Your professional occupation

Your professional title

What does the term *Hazardous Materials Commodity Flow Survey* mean to you? *(Please briefly describe.)*

Which choices describe hazardous materials (hazmat) routing in your LEPC jurisdiction?

(Select all that apply) Please note: If you are completing this survey for multiple LEPCs, please select one that best represents experiences with hazmat commodity flow surveys (CFS) and respond to questions in this survey from that perspective. Also, this survey covers local hazmat CFS practices for both LEPCs and Tribal Emergency Response Commissions (TERCs). We request that questions directed to "LEPCs" should be answered by both LEPCs and TERCs.

☐ It's an ORIGIN for significant quantities of hazardous materials flowing out of the jurisdiction

☐ It's a DESTINATION for significant quantities of hazardous materials flowing into the jurisdiction

☐ Significant quantities of hazardous materials are transported WITHIN jurisdiction (but do not leave)

☐ Significant quantities of hazardous materials are transported THROUGH the jurisdiction.

Rate the level of risk for hazmat transport incidents in your jurisdiction for each mode. Use your initial, "off-the-cuff" reaction. *Scale: 0 = No Risk at all ... through ... 10 = Extreme Risk*

	0	1	2	3	4	5	6	7	8	9	10
Roadway	○	○	○	○	○	○	○	○	○	○	○
Railway	○	○	○	○	○	○	○	○	○	○	○
Waterway	○	○	○	○	○	○	○	○	○	○	○
Pipeline	○	○	○	○	○	○	○	○	○	○	○

How frequently does your LEPC meet formally? *(Select from drop-down list)*

Weekly (40 to 52 times a year)

Bi-Weekly (24 to 36 times a year)

Monthly (12 to 20 times a year)

Bi-Monthly (6 to 8 times a year)

Quarterly (4 or 5 times a year)

Annually (1 to 2 times a year)

Seldom (less than once a year)

Never (Inactive)

When was the last time your LEPC met formally? *(Select from drop-down list)*

       Within last month

       Within last 6 months

       Within last year

       1-2 years ago

       3-4 years ago

       5-7 years ago

       8 or more years ago

       LEPC has never met formally

If your LEPC has never met formally, has it ever functioned on an "informal" basis?

     ◯ Yes, it has functioned on an informal basis

     ◯ No, it has never functioned on an informal basis either

     ◯ Other (please describe)   [   ]

When your LEPC last met formally, how many people attended? *(Select from drop-down list)*

3 or fewer

4 to 6

7 to 10

11 to 15

16 to 25

26 to 50

51 or more

In what years were hazmat commodity flow survey (CFS) studies or evaluations conducted for your LEPC jurisdiction? *(Select all that apply)*

Note: <u>any</u> survey, study, or evaluation involving hazmat commodity flows is considered in this question, regardless of scale, scope, modes, coverage, location, etc.

☐ 2008		☐ 2002	
☐ 2007		☐ 2001	
☐ 2006		☐ 2000	
☐ 2005		☐ 1999	
☐ 2004		☐ 1998 or prior	
☐ 2003		☐ Never conducted	

What number best represents your understanding of the hazmat CFS process?
Scale: 0 = No Understanding at all ... 10 = Complete Detailed Understanding

0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

What were the primary reasons that the most recent hazmat CFS was conducted for your LEPC?
(Select all that apply)

☐ Our LEPC became aware of funding availability

☐ Our LEPC became aware that other LEPCs had conducted CFS

☐ The SERC suggested we conduct a CFS

☐ The CFS seemed like a good way to get a handle on hazmat flows in our area

☐ Communities/regional planning agencies within our LEPC's jurisdiction requested it

☐ An influential hazmat community stakeholder championed it

☐ Other (please describe) [_____]

Who conducted your most recent hazmat CFS? *(Select all that apply)*

☐ It was conducted internally by LEPC members or associates

☐ It was conducted externally by a contractor (who?) [_____]

☐ It was conducted externally by a federal agency (who?) [_____]

☐ Other (please describe) [_____]

What was used to guide how your most recent hazmat CFS was conducted? *(Select all that apply)*

- Used other CFS as examples
- Knowledge about CFS process within your LEPC membership
- Contractor knowledge (experience) about (with) the CFS process
- DOT "Guidance for Conducting Hazardous Materials Flow Surveys"
- HMEP (Grant) Program guidance on conducting CFS
- Instructions from SERC or PHMSA
- Census / Bureau of Transportation Statistics guidance/documents
- TRANSCAER Manual
- Other (please describe) [   ]

What 'existing' (previously compiled) data sources were used for your most recent CFS?
(Select all that apply)

☐ Previous CFS for our LEPC (year, if known?)

☐ CFS conducted by other LEPC, TERC, or SERC

☐ Data provided by transport carriers

☐ Data provided by local industry / fixed facilities

☐ Hazmat accident/incident data

☐ Census / Bureau of Transportation Statistics data

☐ Data provided by state agencies (please describe) [_____]

☐ Data provided by federal agencies (please describe) [_____]

☐ Internet sources (please describe) [_____]

☐ Other (please describe) [_____]

Please rate the quality of local information resources available for your jurisdiction in each category.

	Not available	Low	Moderate	High	Very High
Transport networks	○	○	○	○	○
Industrial facility locations	○	○	○	○	○
Public-use facility locations	○	○	○	○	○
Hazmat routes	○	○	○	○	○

What were the sources for 'new' (not previously compiled) data in your most recent hazmat CFS? *(Select all that apply)*

- [ ] Vehicle/vessel type counts
- [ ] Placard counts
- [ ] Shipping manifests
- [ ] Interviews with local emergency responders (e.g., FD, PD, EMS, etc.)
- [ ] Interviews with industry representatives
- [ ] Interviews with transport carriers
- [ ] Other (please describe) [   ]

Which were the most important data sources for conducting your most recent hazmat CFS?
(Select all that apply)

☐ Previous CFS for our LEPC

☐ CFS from other local or state LEPC

☐ Data provided by transport carriers

☐ Data provided by local industry / fixed facilities

☐ Hazmat accident/incident data

☐ US DOT Bureau of Transportation Statistics data

☐ Data provided by state agencies

☐ Data provided by federal agencies

☐ Internet sources

☐ Vehicle/vessel type counts

☐ Placard counts

☐ Shipping manifests

☐ Interviews with local emergency responders (e.g., PD, FD, EMS, etc.)

☐ Interviews with industry representatives

☐ Interviews with transport carriers

☐ Other (please describe) [＿＿＿＿＿＿＿]

Briefly describe the most significant challenges faced in gaining access to public and private data to support the hazmat CFS and whether/how they were resolved.

When you conducted vehicle/vessel or placard counts, what types of locations were included?
(Select all that apply)

- [ ] Highway intersections
- [ ] Railroad crossings
- [ ] Weigh stations
- [ ] Jurisdictional boundaries (e.g., county lines)
- [ ] Facility boundaries (e.g., entry gates)
- [ ] Ports, truck terminals, or railyards
- [ ] Bridges and/or tunnels
- [ ] Rest areas/truck stops
- [ ] Other (please describe)

Why were these locations identified/selected? *(Select all that apply)*

☐ Key people with specialized knowledge suggested them

☐ High accident rates

☐ High traffic corridor (any mode)

☐ High population density or public use facilities in area

☐ Safe location and shelter for participants

☐ High traffic expected there at specific times

☐ Easiest for participants/industry/carriers

☐ Other (please describe) [   ]

Briefly describe the timing of vehicle/vessel or placard count effort. How were hourly, daily, weekly, monthly, or seasonal variations in traffic addressed?

[   ]

What was most important in selecting the times or locations for vehicle/vessel or placard counts?
(Select all that apply)

☐ Specialized local knowledge (e.g., interviews with police or traffic officials)

☐ Local industry insight (e.g., interviews with industry representatives)

☐ Safety of participants (e.g., not done in heavy traffic areas or adverse weather)

☐ Convenience (e.g., good "field of view")

☐ Logistics (e.g., this was how the people doing it felt it worked best)

☐ Collection accuracy (e.g., no counts at night to avoid vision issues)

☐ Guidelines followed carefully

☐ Other factors (please describe) [   ]

When you examined shipping manifests, what types of locations were included? *(Select all that apply)*

☐ Highway intersections

☐ Railroad crossings

☐ Weigh stations

☐ Jurisdictional boundaries (e.g., county lines, etc.)

☐ Facility boundaries (e.g., entry gates, etc.)

☐ Ports, truck terminals, or railyards

☐ Bridges and/or tunnels

☐ Rest areas/truck stops

☐ Other (please describe) [   ]

How were these locations identified/selected? *(Select all that apply)*

☐ Key people with specialized knowledge suggested them

☐ High accident rates

☐ High traffic corridor

☐ High population density or public use facilities in area

☐ Safe location and shelter for participants

☐ Traffic expected there at specific times

☐ Easiest for participants/industry/carriers

☐ Other (please describe) [   ]

Briefly describe the timing of shipping manifest monitoring effort. how were hourly, daily, weekly, monthly, or seasonal variations in traffic addressed?

What was most important in selecting the locations or times for examining shipping manifests? *(Select all that apply)*

▢ Specialized local knowledge (e.g., interviews with police or traffic officials)

▢ Local industrial insight (e.g., interviews with industry representatives)

▢ Safety of participants (e.g., not done at "bottlenecks" or heavy traffic areas)

▢ Convenience (e.g., good "field of view" or vehicles stopped there anyhow)

▢ Logistics (e.g., this was how the people doing it felt it worked best)

▢ Accuracy of the data collected (e.g., no interviews at night to avoid vision issues)

▢ Guidelines followed carefully

▢ Other factors (please describe)

Who participated in conducting your most recent hazmat CFS? *(Select all that apply)*

☐	Local LEPC members	☐	Hazmat response team
☐	Municipal employees	☐	Private contractor
☐	County employees	☐	University contractor
☐	Local planning agency/authority employees	☐	Government agency contractor
☐	State employees	☐	Volunteers
☐	Local industry representatives	☐	Other (please describe) [_____]
☐	Hazmat incident commander		

Why were these people involved in conducting your most recent hazmat CFS? *(Select all that apply)*

☐ Local community has the technical capability to perform a CFS

☐ Local community staff time was available to conduct the CFS

☐ State resources were available to perform a CFS

☐ Technical capability not locally available

☐ Local community staff time not available

☐ Budget to hire contractor not available

☐ Contractor available and affordable

☐ Industry personnel were made available to conduct the CFS

☐ Other (please describe) [_____]

Resources for the conduct of hazmat CFS often come from a variety of sources. Please complete the table to describe the funding for your LEPC's most recent hazmat CFS as you recall it. For example:

Grant Type/Source	Resources	Comment/Describe
SERC (Fed Grant)	$10000	
County	$1500	50 PD hrs @ $30/hr
Volunteers	$1000	50 Vol hrs @ $20/hr
Source	**Resources**	**Comment/Describe**
SERC (Federal Grant Funding)		
SERC (non-Federal Grant Funding)		
Other Federal Agency		
Other State Agency County		
Municipal		
Industry		
Volunteers		
NGO's		
Other sources		

Once you obtained/collected the hazmat CFS data, what was done to validate its relevance/meaning to your jurisdiction?

What level of detail best describes data that were obtained for your most recent hazmat CFS, for each transport mode...

In terms of its quantity?

	Mode Not Applicable	Data Not Needed	Hazmat Presence Only	Relative Hazmat Quantity (e.g., sm, med, large amount)	Specific Hazmat Quantity (e.g., gal/lbs)
Roadway	○	○	○	○	○
Railway	○	○	○	○	○
Waterway	○	○	○	○	○
Pipeline	○	○	○	○	○

In terms of its material classification?

	Mode Not Applicable	Chemical / Material Class	Chemical / Material Division	Specific Placard ID / Number	Chemical / Material Name
Roadway	○	○	○	○	○
Railway	○	○	○	○	○
Waterway	○	○	○	○	○
Pipeline	○	○	○	○	○

How useful are the hazmat CFS data that were collected for characterizing the hazmat transport risks in your community? *Scale: 0 = Not Useful at all ... 10 = Extremely Useful*

0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

Please provide examples of specific uses your jurisdiction made of the hazmat CFS data.

How confident are you that the hazmat CFS data were analyzed correctly?
Scale: 0 = No Confidence at all ... 10 = Extreme Confidence

0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

How frequently is the data from your most recent hazmat CFS used for any purpose? *(Select from drop-down list)*

Daily (250 or more times a year)

Every few days (75 to 150 times a year)

Weekly (40 to 52 times a year)

Bi-Weekly (24-36 times a year)

Monthly (12 to 20 times a year)

Bi-Monthly (6 to 8 times a year)

Quarterly (4 or 5 times a year)

Annually (1 to 2 times a year)

Periodically (less than once a year)

Never

How was the information from your most recent hazmat CFS actually used? *(Select all that apply)*

☐ Identify emergency response equipment needs

☐ Augment/design emergency warning systems

☐ Guide emergency response training

☐ Community planning and zoning

☐ Locate new hospitals, nursing homes, and mental health care facilities

☐ Locate new schools, day care centers and churches

☐ Locate new prisons, juvenile delinquency centers, and other restricted access facilities

☐ Relocate existing industrial facilities

☐ Designate hazardous materials transportation routes

☐ Other (please describe) [   ]

Which results of your most recent hazmat CFS are the most useful? *(Why?)*

[   ]

How much does your most recent hazmat CFS improve the understanding of transport risks by the following groups? *(Select one level for each group type, as applicable)*

	Not at all	Low	Moderate	High	Very High
Emergency Responders	○	○	○	○	○
Elected Officials	○	○	○	○	○
Public Health Officials	○	○	○	○	○
School Officials	○	○	○	○	○
Community Planners	○	○	○	○	○
General Public	○	○	○	○	○
Other	○	○	○	○	○

What would be the top priority if your LEPC were to conduct a hazmat CFS again? *(Please describe briefly)*

What "bang for your buck" hazmat CFS practices would you recommend to other LEPCs?

Have you ever been asked by another LEPC for a copy of your hazmat CFS?

○ Yes

○ No

Have you ever asked another LEPC for a copy of their hazmat CFS?

○ Yes

○ No

Indicate how much you agree or disagree with each of the following:

Conducting the hazmat CFS was initially seen as burden on the LEPC.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

The members of the LEPC found the hazmat CFS process burdensome.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

The hazmat CFS created a hardship for the LEPC.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

Conducting the hazmat CFS created opportunities to improve local emergency response.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

The hazmat CFS advanced our local understanding of hazardous material flows in the community.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

The hazmat CFS provided the LEPC with an opportunity to improve local emergency plans.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

How frequently does the SERC communicate directly with the LEPC about conducting hazmat commodity flow surveys? *(Select from drop-down list)*

Daily (250 or more times a year)

Every few days (75 to 150 times a year)

Weekly (40 to 52 times a year)

Bi-Weekly (24-36 times a year)

Monthly (12 to 20 times a year)

Bi-Monthly (6 to 8 times a year)

Quarterly (4 or 5 times a year)

Annually (1 to 2 times a year)

Periodically (less than once a year)

Never

What kinds of information are typically provided by the SERC about hazmat CFS?

When your most recent hazmat CFS was completed, to what offices/persons/locations was it distributed? *(Select all that apply)*

☐ LEPC/TERC members	☐ School officials
☐ SERC	☐ Public library
☐ Mayor's offices	☐ Internet (please describe)
☐ City manager offices	☐ Local media (newspaper/TV/Radio)
☐ Council members	☐ Public meetings
☐ County judge	☐ News letters to local residents
☐ County commissioners	☐ Federal agencies
☐ Fire departments	☐ Other LEPCs in your area
☐ Police/sheriff departments	☐ Other (please describe) [_____]
☐ Hospitals and public health officials	☐ None of the above

How important is it that your LEPC members understand the detail about how the hazmat CFS was conducted, in order to interpret its results? *Scale: 0 = Not Important at all ... 10 = Extremely Important*

0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

How frequently do your members communicate with each other specifically about the hazmat CFS? *(Select from drop-down list)*

Daily (250 or more times a year)

Every few days (75 to 150 times a year)

Weekly (40 to 52 times a year)

Bi-Weekly (24-36 times a year)

Monthly (12 to 20 times a year)

Bi-Monthly (6 to 8 times a year)

Quarterly (4 or 5 times a year)

Annually (1 to 2 times a year)

Periodically (less than once a year)

Never

What is the typical mode of communication among your LEPC's membership? *(Select all that apply)*

- Emails
- Phone calls
- Face-to-face meetings
- Regular formal scheduled meetings
- Informal meetings (lunch, dinner, etc.)
- Other (please describe)

Does your LEPC have mechanisms or specific functions for evaluating new ideas about hazardous materials and/or emergency planning?

○ Yes

○ No

To the best of your recollection, what were your LEPC's overall funding sources for the previous five years?

	Operating Budget (non-Grant)	Total HMEP Planning and Training grant funding (not including matching grants from other sources)	Other funding (including matching grants)
2007			
2006			
2005			
2004			
2003			

What kind of grant funding matching mechanisms seem to work best, and why? If there are differences between the best matching funds for commodity flow studies, planning, and training, please explain.

Who are the active participants in your LEPC? *(Select all that apply)*

- ☐ Industry representatives
- ☐ Media representatives
- ☐ Transportation carriers
- ☐ Environmental groups
- ☐ Local elected officials
- ☐ Social/community activists
- ☐ Police/sheriff department officials
- ☐ State officials
- ☐ Fire department officials
- ☐ Public works officials
- ☐ Hazardous materials teams
- ☐ Public health/EMS/hospital officials
- ☐ Emergency managers
- ☐ TRANSCAER representatives
- ☐ Other (please describe) _____

Indicate how much you agree or disagree with each of the following:

Our LEPC has the support of local politicians/elected officials

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

Conducting hazmat CFS for our LEPC has the support of local politicians/elected officials.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

Our jurisdiction's general public is interested in our LEPC.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

Our LEPC has the resources it needs to do its job.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

Conducting hazmat CFS is important for our community.

Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
○	○	○	○	○

What are the primary barriers to conducting hazmat commodity flow surveys for your LEPC?

Is American Chemical Manufacturers' Association CAER program active in your area?

○ Yes

○ No

○ Don't know

How much do the responsibilities and/or activities of the LEPC and CAER program duplicate each other? *Scale: 0 = No Overlap at all ... 10 = Completely Overlapped*

0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

What is the approximate population of your LEPC jurisdiction? [   ]

What is the approximate area of your LEPC jurisdiction? *(In square miles)* [   ]

Which of the following are prevalent employers in your LEPC's region or area? *(Select all that apply)*

	Petrochem industry (refineries, terminals, etc.)		Educational institutions
	Non-petrochem manufacturing		Government agencies
	Transportation industry or agencies		Agriculture
	Retail trade		Tourism and hospitality
	Warehousing and distribution		Mining or raw materials
	Banking and insurance		Forestry or forest products
			Other (please describe)
	Professional/medical services		

What incentives would improve the ability of your LEPC to conduct hazmat commodity flow surveys?

Is there anything else that you would like to tell us about hazmat CFS that has not been covered in this survey?

VERY IMPORTANT: Please be sure to click on the arrow in the lower left corner of this screen when you're finished to record your response and exit the survey.

If you have any questions or comments about this project, please contact:

Dr. George Rogers
Texas A&M University
Hazard Reduction & Recovery Center
(979) 845-7284
grogers@tamu.edu

or

Mr. David Bierling
Texas Transportation Institute
Multimodal Freight Transportation Programs
(979) 862-2710
dhb@tamu.edu

Thank you!

Survey Powered By Qualtrics

APPENDIX C. TEXAS A&M INSTITUTIONAL REVIEW BOARD

PROTOCOL APPROVAL

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TEXAS A&M UNIVERSITY
DIVISION OF RESEARCH AND GRADUATE STUDIES - OFFICE OF RESEARCH COMPLIANCE

1186 TAMU	979.458.1467
College Station, TX 77843-1186	FAX 979.862.3176
1500 Research Parkway, Suite B-150	http://researchcompliance.tamu.edu

Institutional Biosafety Committee	Institutional Animal Care and Use Committee	Institutional Review Board

DATE: 03-Apr-2008

MEMORANDUM

TO: ROGERS, GEORGE O
             778433137

FROM: Office of Research Compliance
            Institutional Review Board

SUBJECT: Amendment

Protocol Number:	2008-0001
Title:	Hazardous Material Commodity Flow Data and Analysis
Review Category:	Exempt from IRB Review

It has been determined that the referenced protocol application meets the criteria for exemption and no further review is required. However, any amendment or modification to the protocol must be reported to the IRB and reviewed before being implemented to ensure the protocol still meets the criteria for exemption.

This determination was based on the following Code of Federal Regulations:
(http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm)

45 CFR 46.101(b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless: (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (b) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Provisions:

This electronic document provides notification of the review results by the Institutional Review Board.

APPENDIX D. CASE SELECTION TABLE FOR RESEARCH SAMPLE

Table D.1. Case selection table for research sample.

Date of Study:		After 1998					1998 or before			
LEPC Role in Project:		LEPC Conducted HMCFS = Yes		LEPC Conducted HMCFS = No		LEPC Cond. HMCFS = Missing	LEPC Conducted HMCFS = Yes		LEPC Conducted HMCFS = No	
Respondent Involvement in LEPC or Project:		'Before Time' or 'Not Involved'	Not 'Before Time' or 'Not Involved'	'Before Time' or 'Not Involved'	Not 'Before Time' or 'Not Involved'	Not 'Before Time' or 'Not Involved'	'Before Time' or 'Not Involved'	Not 'Before Time' or 'Not Involved'	'Before Time' or 'Not Involved'	Not 'Before Time' or 'Not Involved'
Number of 'Unknown'-Type* Responses	0	2	65	2	49	1	2	22		15
	1	1	7	6	10	1	1	4	4	2
	2	2	1	3	3			2		1
	3	1		1	1		1			2
	4						1			
	5			1						
	6									1
	7	1								
Cases Retained (by Column):		0	73	0	62	2	0	28	0	18
Cases Excluded (by Column):		7	0	12	2	0	5	0	4	3
Cases Retained (by Years):		137					46			
Cases Excluded (by Years):		21					12			
Cases Retained:	183									
Cases Excluded:	33									

* Includes *Unknown* , *Don't know* , *Not sure* , or similar responses to the following questions:

What does the term <u>*Hazardous Materials Commodity Flow Survey*</u> mean to you? *(Please briefly describe.)*

What were the primary reasons that the most recent hazmat CFS was conducted for your LEPC? *(Select all that apply)* : Other (please describe)

Who conducted your most recent hazmat CFS? *(Select all that apply)* : It was conducted externally by a contrator (who?)

Who conducted your most recent hazmat CFS? *(Select all that apply)* : Other (please describe)

What was used to guide how your most recent hazmat CFS was conducted? *(Select all that apply)* : Other (please describe)

What 'existing' (previously compiled) data sources were used for your most recent CFS? *(Select all that apply)* : Other (please describe)

What were the sources for 'new' (not previously compiled) data in your most recent CFS? *(Select all that apply)* : Other (please describe)

What were the most important data sources for conducting your most recent hazmat CFS *(Select all that apply)* : Other (please describe)

Briefly describe the most significant challenges faced in gaining access to public and private data to support the hazmat CFS and whether/how they were resolved,

Who participated in conducting your most recent hazmat CFS? *(Select all that apply)* : Other (please describe)

Why were these people involved in conducting your most recent hazmat CFS? *(Select all that apply)* : Other (please describe)

Once you obtained/collected the hazmat CFS data, what was done to validate its relevance/meaning to your jurisdiction?

Please provide examples of specific uses your jurisdiction made of the hazmat CFS data.

How was the information from your most recent hazmat CFS actually used? *(Select all that apply)* : Other (please describe)

Which results of your most recent hazmat CFS are the most useful? *(Why?)*

What would be the top priority if your LEPC were to conduct a hazmat CFS again? *(Please describe briefly)*

What "bang for your buck" hazmat CFS practices would you recommend to other LEPCs?

What kind of grant funding matching mechanisms seem to work best, and why?

What are the primary barriers to conducting hazmat commodity flow surveys for your LEPC?

What incentives would improve the ability of your LEPC to conduct hazmat commodity flow surveys?

Is there anything else that you would like to tell us about hazmat CFS that has not been covered in this survey?

APPENDIX E. PRINCIPAL COMPONENTS ANALYSIS, RELIABILITY ANALYSIS, AND SPECIFICATION OF DEPENDENT AND INDEPENDENT VARIABLES

E.1. Principal Components Analysis

Principal component analysis (PCA) can be used for reduction of data sets. While some sources suggest that PCA is only appropriate for interval or ratio data, it has been used for reduction of ordinal and dichotomous data as well. Various authors and instructors (Field, 2005; Garson, 2011a; Peacock, undated; Pett, Lackey, & Sullivan, 2003; A. J. Schwab, 2007) have provided criteria by which PCA can be used for exploratory reduction of data into indices, as described below. Specific differences among criteria by authors are indicated where applicable.

- Results must be interpretable, and data reduction techniques should not be used in place of sound theoretical reasoning.

- Analysis of ordinal or nominal variables analyzed using PCA should be interpreted with caution.

- Garson (2011a) identifies that minimum criterion for sample size varies among authors and points out most agree that the sample size must be greater than 50. Other authors (Costello & Osborne, 2005; MacCallum, Widaman, Zhang, & Hong, 1999) identify that the characteristics of the underlying data, number of variables, and number of factors affect the sample size required for adequate model performance in factor analysis.

- Schwab (2007) suggests that the ratio of cases to variables must be 5 to 1 or larger. Costello and Osborne (2005) note that a heuristic for many researchers in factor analysis is a ratio of 10 cases for each variable, but that ratios of 2 to 1 were evidenced in practice (which was not a recommendation).

- The correlation matrix for the variables must contain two or more correlations of .30 or greater (A. J. Schwab, 2007). Very high correlations can create problems of multicollinearity.

- The number of factors retained may be determined by those with Eigenvalues greater than 1.0, but Costello and Osborne (2005) point out a consensus in the literature that this criterion is among the 'least accurate'. They recommend that a scree plot is a more accurate method of selecting number of factors and is one that is common in statistical software packages.

- Schwab (2007) indicates that the cumulative proportion of variance for components with Eigenvectors greater than 1.0 should be 60% or higher and that solutions in which the cumulative proportion of variance explained is less 60% should be interpreted with caution. Garson (2011a) suggests that explaining the variance with as few factors as possible could use a criterion of 50% cumulative variance explained. Pett, Lackey, and Sullivan (2003) indicate that social sciences research could result in extracted factors with lower explained variance, around 50-60%, than might be expected in natural sciences where 90% cumulative explained variance might be a criterion.

- Variables with individual measures of sampling adequacy less than .50 should be considered for removal, and the overall measure of sampling adequacy should be .50 or higher.

- The Bartlett test of sphericity must be statistically significant.

- Schwab and other instructors (Field, 2005; Hansen, 2011) indicate that the communality value for each variable should be .50 or higher. However, Garson (2011a) cautions that even a high communality of .75 may be meaningless unless a factor in which a variable is loaded is interpretable, and a low communality of .25 may be meaningful for well-defined factors. Costello and Osborne (2005) indicate that communalities in the range of .40 to .70 are common in social sciences and that a communality of less than .40 may indicate a lack of relationship with other items or suggest the possibility of an additional factor that should be considered. MacCallum, et al. (1999) present more-nuanced criteria based on the number of cases and factors in the analysis, and the values of communality considered. Based on Monte Carlo simulations, their results suggest that for a samples size of 200 cases, a wide range of communalities (between .2 and .8) can be acceptable. However, a low range of communalities (between .2 and .4) for this number of cases is not acceptable when the ratio of variables to factors is 20:7.

- Schwab (2007) indicates that if a variable has complex structure, (loadings or correlations above .40 or greater) on more than one component, it should be removed from the analysis.

- If a component has only a single variable loading on it, the variable should be removed (A. J. Schwab, 2007).

- The process is iterative until all criteria are met.

E.2. Reliability Analysis

Given Schwab's (2007) recommendation that nominal variables analyzed using PCA should be interpreted with caution, the primary variables comprising each dependent variable component grouping were also evaluated for their reliability, using Cronbach's alpha. With its origins in psychometric analysis, Cronbach's alpha is widely used as a lower bound among a number of different measures of scale reliability (Sijtsma, 2009), and when used for dichotomous data it is presented for the same results as the Kuder-Richardson KR-20 formula (Kuder and Richardson, 1937, as cited in Sijtsma, 2009) in SPSS.

There does not appear to be a well-established set of criteria for lower acceptable bounds of Cronbach's alpha (Bowling, 1997). Nunnally and Bernstein (1994) indicate that "a satisfactory level of reliability depends on how a measure is being used" (p. 264). In applications for which scales comprised of test scores are used for making decisions about individuals, a reliability of .95 might be desired (Nunnally & Bernstein, 1994). When discussing circumstances in which researchers have a "very low" alpha, Nunnally (1967) provides an example where if "coefficient alpha is only .30 for a 40-item test, the experimenter should reconsider his measurement problem" (p. 210). This example is repeated using similar language in later editions by Nunnally as well (Nunnally, 1978; Nunnally & Bernstein, 1994).

While some authors in various literatures suggest .7 is a minimum alpha value, the term used for that value is actually "modest" in Nunnally and Bernstein's later work (Nunnally & Bernstein, 1994, p. 265), whereas Nunnally's earlier work describes alpha value of .6 or .5 as "modest" (Nunnally, 1978, p. 226) and which may be sufficient in the earlier stages of research. This is similar to Helmstader's (1964) indication of a reliability value of .5 being sufficient to evaluate differences of a quarter standard deviation across standardized grade-group test scores at the level of group accomplishment, with a 5 to 1 chance of being correct. As Helmstader concludes, "in some instances a reliability which is far from perfect may be the best yet, or much better than impressionistic judgment or than simply ignoring the trait because no measuring device is available" (1964, p. 85).

Cortina (1993) discusses how values of Cronbach's alpha "must be interpreted with some caution" because they are highly sensitive to the number of items included in the scale, and that "alpha can be rather high and acceptable by the standards of many (greater than .70) in spite of the low average item intercorrelation or multi-dimensionality, provided there is a sufficient number of items" (p. 103). Cortina (1993) illustrates that a three-item scale with an alpha of .8 has an average interitem correlation of .57, while a 10 item scale with the same alpha value has an average interitem correlation of .28. Although the alpha values are the same, the interitem correlations for variables in the scale are greatly different. However, both scales would commonly be considered to have a 'good' Cronbach's alpha value.

The variables in this assessment were measured once, not longitudinally or in repeat measures. The nature of the work is not intended to specify a treatment for any individuals based on survey response or 'test performance'. In addition, the nature of this research is exploratory. To the author's knowledge, there has been no prior research on the selection of commodity flow study information sources. Thus, .5 is used as a general criterion against which to evaluate the acceptability of Cronbach's alpha for these measures.

E.3. HMCFS Information Type Components

The survey inquired about data sources that used for LEPC's most recent HMCFS. The 14th question of the survey asked: "What 'existing' (previously compiled) data sources were used for your most recent CFS?" Informants indicated whether or not the data source was used by a checkbox, and responses were non-exclusive. Potential responses included:

- Previous CFS for our LEPC

- CFS conducted by other LEPC, TERC, or SERC

- Data provided by transport carriers

- Data provided by local industry / fixed facilities

- Hazmat accident/incident data

- Census / Bureau of Transportation Statistics data

- Data provided by state agencies

- Data provided by federal agencies

- Internet sources

- Other (please describe)

The 16th question of the survey asked: "What were the sources for 'new' (not previously compiled) data in your most recent hazmat CFS?" Informants indicated whether or not the data source was used by a checkbox, and responses were non-exclusive. Potential responses included:

- Vehicle/vessel type counts

- Placard counts

- Shipping manifests

- Interviews with local emergency responders (e.g., FD, PD, EMS, etc.)

- Interviews with industry representatives

- Interviews with transport carriers

- Other (please describe)

Responses to 'Other' information source categories were examined for common themes in informant descriptions.

There were six text responses provided to 'Other' variables that suggested that specific types of information sources that were not indicated as having been used when they should have been. These include data from industry (3 responses), vehicle/vessel counts (3 responses), and data from transport carriers (1 response). These specific variables were recoded with an affirmative response for use of these information sources, and a record retained of the cases and variables for which recoding was performed. There were nine text responses that indicated some other type of information

source, and there were used to create a new binary variable for 'Other information sources.'

Informants were also asked to describe the data sources provided by state agencies, federal agencies, and Internet sources. Examination of descriptor information revealed no consistencies in responses that could allow for further categorization of these data sources. This suggests that the variables for specific types of information sources are comprehensive, representative, and well-specified. Together, these data sources can be interpreted as a combined set of information sources that are used by LEPCs for conducting HMCFS.

E.3.1. Identification of information type components

The procedures described in Sections E.1 and E.2 were used to reduce the 16 dichotomous information source variables. There were 173 cases for the initial set of 16 variables, providing a ratio of approximately 11 cases per variable. There were five correlations of .30 or higher in the initial correlation matrix, and another four correlations between .25 and .30. Although six components were extracted in the initial solution with Eigenvalues above 1.0, examination of a scree plot indicated that a solution of between two and five components can be considered (Figure E.1).
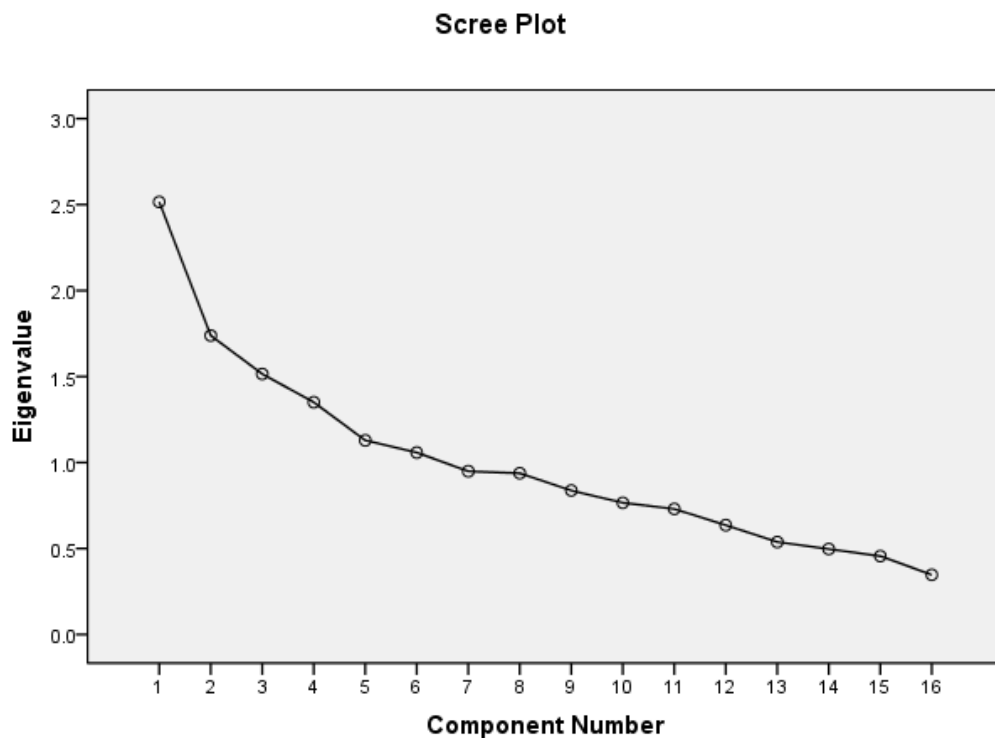
Figure G.1. Scree plot for initial HMCFS information type component solution.

A three-component solution using 9 variables (a ratio of 3:1) resulted in cumulative explained variance of greater than 56 percent and an overall measure of sampling adequacy of .552 was ultimately identified as providing the best explanatory quality and performance.

Stepwise elimination of variables was performed using criteria guidelines and consistency in theoretical constructions of components. Variables that were excluded from the PCA analysis in order of their removal for the three-component solution and their respective reasons for exclusion (in parenthesis) are 'CFS conducted by other LEPC, TERC, or SERC' (communality < .03), 'Previous CFS for our LEPC'

(communality < .11), 'Other information was used as data source' (communality < .21),

'State agency was information source' (communality < .21), 'Internet was information

source' (communality <.31), 'Federal agency was information source' (communality <

.25), and 'Census / Bureau of Transportation Statistics data' (communality < .26).

Table E.1 lists descriptive statistics for variables that remained in the final

information type component solution using this procedure. There are a total of 173 cases

for 9 variables, with an average of 19.2 cases per variable. Table E.2 lists the correlation

matrix for the variables. There are six correlations of .3 or greater. Note that when both

variables are dichotomous, SPSS automatically calculates the phi coefficient for exact

correlations (Garson, 2010). The cumulative proportion of variance explained by the

four components is 56%, as listed in Table E.3.

Table E.1. Descriptive statistics for variables remaining in final information type component solution.

Descriptive Statistics

Variable	Mean	Std. Deviation	Analysis N
Vehicle/vessel type counts were information source	.55	.499	173
Placard counts were information source	.54	.500	173
Local industry/fixed facilities were information source	.43	.497	173
Data from transport carriers was information source	.35	.477	173
Hazmat incident/accident data were information source	.33	.471	173
Interviews with transport carriers were information source	.23	.423	173
Shipping manifest reviews were information source	.12	.321	173
Interviews with industry representatives were information source	.25	.437	173
Interviews with local emergency responders were information source	.25	.433	173

Table E.2. Correlation matrix for variables remaining in final information type component solution.

	1	2	3	4	5	6	7	8	9
1	1.000								
2	.545	1.000							
3	-.051	.006	1.000						
4	.074	-.039	.343	1.000					
5	-.156	-.098	.305	.316	1.000				
6	-.027	-.048	.074	.205	-.034	1.000			
7	.110	.041	-.024	.002	.054	.359	1.000		
8	-.164	-.157	.266	.104	.099	.341	.121	1.000	
9	-.151	-.171	.145	-.026	.166	.129	.169	.248	1.000

1. Vehicle/vessel type counts were information source
2. Placard counts were information source
3. Local industry/fixed facilities were information source
4. Data from transport carriers was information source
5. Hazmat incident/accident data were information source
6. Interviews with transport carriers were information source
7. Shipping manifest reviews were information source
8. Interviews with industry representatives were information source
9. Interviews with local emergency responders were information source

Table E.3. Eigenvalues and variance explained for final information type component solution.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.102	23.358	23.358	2.102	23.358	23.358	1.716	19.063	19.063
2	1.564	17.374	40.732	1.564	17.374	40.732	1.693	18.806	37.869
3	1.406	15.623	56.355	1.406	15.623	56.355	1.664	18.486	56.355
4	.952	10.574	66.929						
5	.883	9.806	76.735						
6	.643	7.148	83.883						
7	.573	6.363	90.245						
8	.503	5.587	95.833						
9	.375	4.167	100.000						

Extraction Method: Principal Component Analysis.

Variable measures of sampling adequacy range are given in Table E.4 and range between .48 and .68. A couple of these are slightly less than .50, but not greatly so. The overall measure of sampling adequacy is .552. The Bartlett test of sphericity is statistically significant (p = .000). Communalities for the variables are listed in Table E.5. The rotated component matrix (Varimax with Kaiser rotation) is shown in Table E.6.

Except for interviews with local emergency responders, which was retained due to conceptual relationship with other variables in its component, the communalities for retained variables are above .4, and component loadings are above .5. The rotated component matrix suggests components associated with distinct types of information sources. Theoretical interpretations and scalar measures for the three information type components, which are associated with local data sources, are discussed below.

Table E.4. Communalities for variables remaining in final information type component solution.

Communalities

Variable	Initial	Extraction
Vehicle/vessel type counts were information source	1.000	.737
Placard counts were information source	1.000	.678
Local industry/fixed facilities were information source	1.000	.584
Data from transport carriers was information source	1.000	.581
Hazmat incident/accident data were information source	1.000	.512
Interviews with transport carriers were information source	1.000	.624
Shipping manifest reviews were information source	1.000	.558
Interviews with industry representatives were information source	1.000	.471
Interviews with local emergency responders were information source	1.000	.328

Extraction Method: Principal Component Analysis.

Table E.5. Measures of sampling adequacy for variables remaining in final information type component solution.

Variable	MSA
Vehicle/vessel type counts were information source	.515
Placard counts were information source	.534
Local industry/fixed facilities were information source	.620
Data from transport carriers was information source	.482
Hazmat incident/accident data were information source	.564
Interviews with transport carriers were information source	.504
Shipping manifest reviews were information source	.497
Interviews with industry representatives were information source	.658
Interviews with local emergency responders were information source	.678

Table E.6. Rotated component matrix for final information type component solution.

Rotated Component Matrix[a]

	Component		
Variable	**1**	**2**	**3**
Vehicle/vessel type counts were information source	.857	-.015	.039
Placard counts were information source	.822	-.002	-.033
Local industry/fixed facilities were information source	-.030	.758	.093
Data from transport carriers was information source	.143	.743	.088
Hazmat incident/accident data were information source	-.187	.690	-.034
Interviews with transport carriers were information source	.027	.057	.787
Shipping manifest reviews were information source	.171	-.106	.720
Interviews with industry representatives were information source	-.289	.253	.569
Interviews with local emergency responders were information source	-.366	.108	.427

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Except for interviews with local emergency responders, which was retained due to conceptual relationship with other variables in its component, the communalities for retained variables are above .4, and component loadings are above .5. The rotated component matrix suggests three components associated with distinct types of information sources.

E.3.2. Information type component one: Original technical information.

The first component is identified as *original technical information* (*OTI*). This component loads on placard counts and vehicle/vessel type counts. Cronbach's alpha for these two variables is .645. These data sources imply the collection of data through traffic surveys. They indicate a dimension of local, original technical data. Although conceptually similar, these two types of traffic surveys are different. A vehicle/vessel type count is based on observations of vehicles and storage vessels used in transportation practice, but does not imply recorded observation of material hazards transported by vehicles. A placard count is based on observations of hazardous materials placards which informs about the nature of the hazard being transported, but does not imply recorded observation of the vehicles by which those hazards are or are not transported with. In either of these counts, information users have control over the type, amount, and nature of data that are collected, but they must expend effort (which may be considerable) for data collection, reduction, and analysis.

E.3.3. Information type component two: Secondary technical information.

The second component is identified as *secondary technical information* (*STI*). This component loads on data from transport carriers, data provided by local

industry/fixed facilities and HazMat incident/accident data. Cronbach's alpha for these three variables is .583, and removal of any variables results in a lower alpha.

These variables imply a dimension of secondary technical (quantitative) data. The information user must have access to the source of previously existing compiled data, or a source must provide the data to the information user. These data likely have a very strong local component: local data users have greater access to local transport carriers than non-local transport carriers. They may also have local access to incident/accident data, and many nonlocal HazMat incident or accident data sources can be queried for specific areas such as individual local jurisdictions. Provision of data by one entity to another implies an element of control by the provider over the type, amount, and nature of information that are released, even considering legal requirements. Users must evaluate the data for meaning to its application, but they do not have to collect original (new) data.

E.3.4. Information type component three: Communicative information.

The third component is identified as *communicative information* (*CI*). The variables associated with this component are interviews with transport carriers, interviews with industry representatives, shipping manifest reviews, and interviews with local emergency responders. Interviews with local emergency responders had lower communality (less than .37) but has a strong theoretical relationship with other remaining communicative-based variables, and was retained in the component structure.

Three of these variables indicate a dimension of communicative information that is obtained through interviews. As with secondary technical information, these data

likely have a very strong local component: data users will likely have greater access to local representatives from transport carriers, industry representatives, and emergency responder than non-local. Presumably, interviews would result in a different, more subjective type of information than would be obtained simply from an examination of raw data. Importantly, the direct communication provided by an interview can result in questions or topics of discussion that interview participants do not have control over and/or may not be comfortable with. Effort must be expended to conduct interviews and compile interview information, and both personal and organizational communication barriers must be overcome.

Admittedly, interviews with industry, transport carriers, and emergency responders are not exactly the type of citizen participation envisioned by communicative theorists. The challenges for obtaining public participation in LEPCs have been previously noted, and industry and transport carriers are a part of what Burby (2003) terms as an 'iron triangle' of groups that dominate citizen involvement in plan making. Flyvbjerg (1998) documents how public safety agencies, along with local business interests and media, cooperated to thwart progressive transportation planning interests. These examples notwithstanding, because industry is among the more active participants in LEPCs and a key source of LEPC support, and because HMCFS are focused on HazMat transportation, it would be a reasonable expectation for LEPCs to engage these stakeholders through communicative practices such as interviews. Since emergency responders are those whose responsibility is public protection from chemical hazards, and emergency responders are frequently involved in LEPCs, it would also be a

reasonable expectation for LEPCs to engage these stakeholders in interviews. LEPCs that are not communicating with these types of stakeholders would probably be much less likely to engage with other types of stakeholders that are less involved in or impacted by the LEPC.

Shipping manifest reviews were also associated with this factor component, and such evaluations *can* include elements of communications activities. For example, an interviewer could request to view shipping papers directly from transport carrier operators such as truck drivers, and discuss aspects of the shipment including load configurations, origin/destination, and last/next stopping points. However, the author's experience with these types of interactions at venues such as inspection stations and check-points indicates that truck drivers are often reticent to engage in meaningful dialogue on these topics, given pressures for maintaining delivery schedules, concerns that the interviews constitute an enforcement activity, proprietary concerns, and authority to do so from their employers (interactions at truck stops and rest stops may prove more productive with a minority of drivers). What typically results most directly from these interactions is collection of raw data from shipping documents. These evaluations can also constitute a review of shipping papers provided directly by shippers and receivers, or by carriers such as trucking companies or railroads. Analysis of such raw data is a much more time and computationally intensive activity that involves very little communicative engagement. Because of the conceptual linkage in communicative activity through interviews, and ambiguity in the conceptual relationship in shipping manifest reviews, this element was not included with the communicative information

variable construction for its primary assessment of as a dependent variable. It was however included with communicative information for purposes of constructing the measure of information selection diversity for number of selected HMCFS information types, since not including this variable with any conceptual grouping would require it to be considered by itself for that analysis and thus place undue emphasis on the role of that variable.

The resulting Cronbach's alpha for the three interview-specific variables is .478, which is slightly below a cutoff value of .5, and not substantially different from the Cronbach's alpha of .527 for the four-variable set. This measure was created by a summation of each of the three interview-specific binary variables associated with the component.

E.4. HMCFS Participant Type Components

The 27th survey question asked 'Who participated in conducting your most recent hazmat CFS?' Informants indicated involvement by different types of participants in their most recent HMCFS using a checkbox, and responses were non-exclusive. Potential responses included:

- Local LEPC members
- Municipal employees
- County employees
- Local planning agency/authority employees
- State employees
- Local industry representatives

- Hazmat incident commander

- Hazmat response team

- Private contractor

- University contractor

- Government agency contractor

- Volunteers

- Other (please describe)

There were six text responses provided to 'Other' participants that suggested recoding of responses for specific types of HMCFS participants, including contractor (coded as private contractor, 1 case), county employees (1 case), LEPC members (2 cases), and local planning agency/authority employees (1 case). These participant type variables were recoded with an affirmative response, and a record retained of the cases and variables for which recoding was performed. There were 15 text responses provided by informants which suggested that other types of emergency responders or emergency managers participated in the HMCFS project besides HazMat responders. A new variable was created for these cases called 'Other responder-related professions.' There were six text responses that indicated some other type of participant group, and there were used to create a new binary variable for 'Other HMCFS participants.'

Survey responses about HMCFS participants were analyzed using Principal Components Analysis and conceptual assessment. Examination of a scree plot (Figure E.2) for the full set of variables suggested retaining two components.
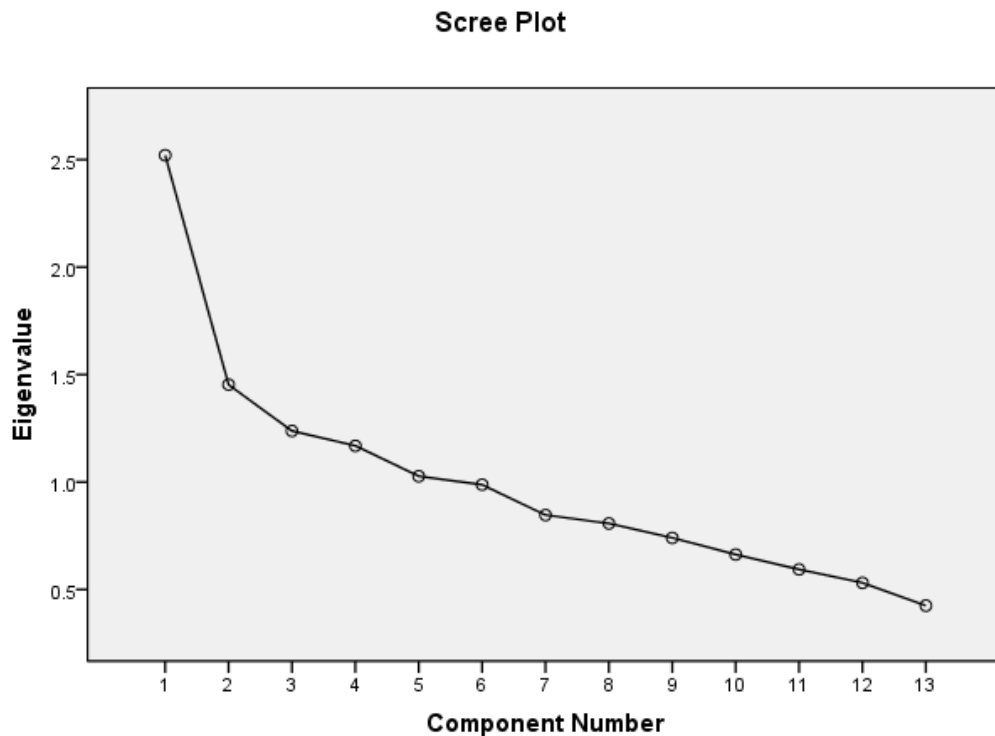
Figure E.2. Scree plot for initial HMCFS participant type component solution.

Variables that were eliminated from the PCA analysis in order of elimination with respective reasons for elimination (in parenthesis) are 'Other responder participants' (individual measure of sampling adequacy < .5), 'University contractor' (individual measure of sampling adequacy < .5), 'Other personnel' (communality < .05), 'Private contractor' (communality < .32), 'Volunteers' (communality < .28), 'Government agency contractor' (communality < .26), 'Local LEPC members' (communality <.27), 'Local planning agency/authority employees' (communality < .32), and 'Local industry representatives' (complex loading on two components). As a result of that analysis, two different components of HMCFS participants were identified. One

component is comprised of municipal employees, county employees, and state

employees, and another component is comprised of HazMat response team members and

HazMat incident commanders (HazMat responders).

Table E.7 lists the final selection of variables that remained from the original set

using this procedure. There are a total of 183 cases for 5 variables, with an average of

36.6 cases per variable. Table E.8 lists the correlation matrix for the variables. There

are two correlations above .30. The two participant type components have a cumulative

proportion of variance explained greater than 69%, as listed in Table E.9.

Table E.7. Descriptive statistics for variables remaining in final HMCFS participant factor solution.

Descriptive Statistics

Variable	Mean	Std. Deviation	Analysis N
County employees participated in HMCFS	.36	.480	183
Municipal employees participated in HMCFS	.14	.344	183
State employees participated in HMCFS	.15	.361	183
HazMat response team participated in HMCFS	.19	.394	183
HazMat incident commander participated in HMCFS	.14	.350	183

Table E.8. Correlation matrix for variables remaining in final participant factor solution.

	1	2	3	4	5
1	1.000				
2	.303	1.000			
3	.287	.185	1.000		
4	.046	.049	.256	1.000	
5	.221	.066	.131	.399	1.000

1. County employees
2. Municipal employees
3. State employees
4. HazMat response team
5. HazMat incident commander

Table E.9. Eigenvalues and variance explained for final participant factor solution.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.787	35.736	35.736	1.787	35.736	35.736	1.494	29.882	29.882
2	1.176	23.524	59.260	1.176	23.524	59.260	1.469	29.378	59.260
3	.817	16.347	75.607						
4	.731	14.613	90.220						
5	.489	9.780	100.000						

Extraction Method: Principal Component Analysis.

Variable measures of sampling adequacy range between .501 and .626 and are given in Table E.10. The overall measure of sampling adequacy is .549. The Bartlett test of sphericity is statistically significant (p = .000). Communalities for the variable are listed in Table E11. The rotated component matrix (Varimax with Kaiser rotation) is shown in Table E.12.

Table E.10. Measures of sampling adequacy for variables remaining in final participant type component solution.

Variable	MSA
County employees participated in HMCFS	.542
Municipal employees participated in HMCFS	.626
State employees participated in HMCFS	.602
HazMat response team participated in HMCFS	.501
HazMat incident commander participated in HMCFS	.529

Table E.11. Communalities for variables remaining in final participant factor solution.

Communalities		
Variable	Initial	Extraction
County employees	1.000	.614
Municipal employees	1.000	.578
State employees	1.000	.428
HazMat response team	1.000	.722
HazMat incident commander	1.000	.620

Extraction Method: Principal Component Analysis.

Table E.12. Rotated component matrix for final participant factor solution.

Rotated Component Matrix^a

	Component	
Variable	**1**	**2**
County employees participated in HMCFS	.777	.101
Municipal employees participated in HMCFS	.755	-.089
State employees participated in HMCFS	.553	.350
HazMat response team participated in HMCFS	.007	.850
HazMat incident commander participated in HMCFS	.121	.778

Extraction Method: Principal Component Analysis.

Rotation: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

A cutoff factor loading value of .40 is used to identify category groupings. The rotated component matrix suggests two distinct types of participants. Based on Schwab's (2007) criterion, a PCA conducted on a set of dichotomous variables must be interpreted with caution even when all other criteria are satisfied. Logical and theoretical interpretation of variable loadings on the components can help validate the use and results of PCA for the participant groups.

E.4.1. Participant component one: Municipal, county, and state employees

The first HMCFS participant component is identified as *municipal, county, and state employees* (*MCS*) participants. This component loads on municipal employee, county employee, and state employee participation in the HMCFS. Cronbach's alpha for

these variables is .508. They have a conceptual relationship in that they imply a dimension of participants from local government agencies. Although different agencies will have different cultures, each will have formal rules, norms, and procedures—and thus share the likelihood of having some type of *bureaucratic structure*. However, the breadth of these participant categories precludes identifying a particular personality type, educational background, or other type of categorization.

Since survey informants could also indicate that LEPC members could participate in the HMCFS, and responses for this variable did not load on this factor component, it is interpreted that informants generally differentiated between LEPC membership who were local agency employees (e.g., firefighters, emergency managers) and external project participants from municipal or county agencies.

E.4.2. Participant component two: HazMat responders.

The second HMCFS participant component is identified as *HazMat responders*. This component loads on HazMat incident response team and HazMat incident commander participation and in the HMCFS. Cronbach's alpha for these variables is .595. These participants have specific and highly specialized training for dealing with hazardous materials incidents. Traditionally HazMat responders have been housed in or closely allied with fire departments or public safety agencies, or less often they are separate regional entities. These organizations will share similar structures, rules, norms, and operating protocols.

APPENDIX F. MEASURES, VARIABLES, AND DATA SOURCES

Table F.1. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
State LEPC is located in, includes:																				
LEPC is in Missouri	B	1,2	X																	
LEPC is in Pennsylvania	B	1,2	X																	
LEPC is in Texas	B	1,2	X																	
LEPC is in West Virginia	B	1,2	X																	
LEPC is in state other than Missouri, Pennsylvania, Texas, or West Virginia	B	1,2	X																	
Region LEPC is located in, includes:																				
LEPC region is in Northeast U.S.	B	1,2	X																	
LEPC region is in South U.S.	B	1,2	X																	
LEPC region is in Midwest U.S.	B	1,2	X																	
LEPC region is in West U.S.	B	1,2	X																	
Major area employers (not mutually exclusive), includes:																				
Petrochemical industry	B	1		X																
Agriculture	B	1		X																
Transportation industry or agencies	B	1		X																
Warehousing and distribution	B	1		X																
Non-petrochemical manufacturing	B	1		X																
Retail trade	B	1		X																
Banking and insurance	B	1		X																
Professional/medical services	B	1		X																
Educational institutions	B	1		X																
Government agencies	B	1		X																
Tourism and hospitality	B	1		X																
'Other' economic sectors	B	1		X																
Mining or raw materials	B	1		X																
Forestry or forest products	B	1		X		X														

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
Diversity of major area employer groups	R	2				X														
Jurisdiction's level of risk for HazMat transport incident, includes:																				
Roadway	O	1			X															
Railway	O	1			X															
Pipeline	O	1			X															
Waterway	O	1			X															
Patterns of HazMat transport in jurisdiction, includes:																				
Jurisdiction is a significant HazMat origin	B	1			X															
Jurisdiction is a significant HazMat destination	B	1			X															
Significant HazMat is transported within community	B	1			X															
Significant HazMat is transported through community	B	1			X															
Jurisdiction population	R	3				X														
Percent of population that is White	R	3				X														
Percent of population that is African American	R	3				X														
Percent of population that is other ethnicity	R	3				X														
Median per capita income adjusted for cost of living	R	3,4				X														
Median household income adjusted for cost of living	R	3,4				X														
Jurisdiction land area	R	5				X														
Percent population growth	I	6				X														
Jurisdiction population density	R	7				X														
2003 Rural-Urban Continuum Code	O	7				X														
Housing stress county	B	7				X														

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
Low-education county	B	7				X														
Low-employment county	B	7				X														
Persistent poverty county	B	7				X														
Population loss county	B	7				X														
Persistent child poverty county	B	7				X														
Level of agreement that LEPC has support of local politicians	O	1					X													
Level of agreement that conducting HMCFS has had support of local politicians	O	1					X													
Percent of jurisdiction that voted Republican for U.S. President in 2008	R	8					X													
Absolute difference between percent of jurisdiction that voted R and percent of county that voted D for U.S. President in 2008	R	8					X													
Level of agreement that jurisdiction's general public is interested in LEPC	O	1					X													
Level of agreement that conducting HMCFS is important for community	O	1					X													
Frequency of formal LEPC meetings	O/R	1						X												
Attendance at last LEPC meeting	O/R	1						X												
Type of LEPC participants, including:																				
Industry representatives	B	1							X											
Local elected officials	B	1							X											
Media representatives	B	1							X											
Social/community activists	B	1							X											
Environmental groups	B	1							X											
Fire department officials	B	1							X											
Emergency managers	B	1							X											

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
																				(Measures)
Police/sheriff department officials	B	1							X											
Public health/EMS/hospital officials	B	1							X											
Hazardous materials teams	B	1							X											
Public works officials	B	1							X											
State officials	B	1							X											
Transportation carriers	B	1							X											
TRANSCAER representatives	B	1							X											
'Other' types of participants	B	1							X											
Number of different LEPC participant groups	R	2						X						X						
Number of years in which LEPC has conducted HMCFS	R	2						X					X							
Frequency that LEPC members communicate specifically about HMCFS	O,R	1						X						X						
Frequency of SERC communications with LEPC specifically about HMCFS	O,R	1												X						
LEPC received funding in 2007	B	2								X										
Number of different funding sources received in 2007	R	2								X										
2007 LEPC total budget per capita	R	2,3								X										
Level of agreement that LEPC has the resources to do its job	O	1								X										
Number of non-local funding sources obtained for most-recent HMCFS	I	2								X										
Amount of non-local funding obtained for most-recent HMCFS, per capita	R	2,3								X										
Significant barriers for LEPC to conduct HMCFS includes funding	B	2								X										

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
Type of LEPC, includes:																				
LEPC is partly or totally municipal	B	2,9									X									
LEPC is partly or totally county	B	2,9									X									
LEPC is partly or totally regional	B	2,9									X									
LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials	B	1										X								
Types of guidance used for conducting most-recent HMCFS (not mutually exclusive), including:																				
Other HMCFS examples	B	1											X							
Knowledge within LEPC membership	B	1											X							
'Other' guidance–prior experience with HMCFS or personal knowledge	B	1											X							
Contractor knowledge/experience with process	B	1											X							
U.S. DOT "Guidance"	B	1											X							
HMEP Grant Program guidance	B	1											X							
Instructions from SERC or PHMSA	B	1											X							
Census/Bureau of Transportation Statistics guidance	B	1											X							
TRANSCAER manual	B	1											X							
'Other' guidance–state or federal documents or instruction	B	1											X							
Level of understanding of HMCFS process	O	1											X							
Significant barriers for LEPC to conduct HMCFS includes knowledge or expertise about process	B	2											X							
Percent of responding LEPCs in state that reported conducting HMCFS	R	2											X	X							

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
													Measures							
LEPC has ever been asked by another LEPC for a copy of its HMCFS	B	1											X	X						
LEPC has ever asked another LEPC for a copy of their HMCFS	B	1											X	X						
Primary modes of communication among LEPC members (not mutually exclusive), includes:																				
E-mails	B	1												X						
Phone calls	B	1												X						
Face-to-face meetings	B	1												X						
Regular formal scheduled meetings	B	1												X						
Informal meetings	B	1												X						
'Other' means of communication	B	1												X						
Primary reasons why HMCFS was conducted includes:																				
LEPC became aware of funding availability	B	1								X					X					
LEPC became aware that other LEPCs had conducted HMCFS	B	1											X	X	X					
Communities/regional planning agencies requested the HMCFS	B	1											X	X						
The HMCFS seemed like a good way to get a handle on HazMat flow	B	1											X		X					
'Other'–As part of LEPC planning activities including plan updates	B	1													X					
SERC suggested the LEPC conduct HMCFS	B	1											X	X						
An influential HazMat community stakeholder championed the HMCFS	B	1													X					

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
Measures																				
Reasons why project participants were involved in conducting HMCFS (not mutually exclusive), includes:																				
Budget to hire contractor was not available	B	1								X						X				
Contractor was available and affordable	B	1								X						X				
Local community has technical capability	B	1											X			X				
Technical capability was not locally available	B	1											X			X				
Local community staff time was available	B	1														X				
Local community staff time was not available	B	1														X				
Industry personnel were made available	B	1														X				
State resources were available	B	1														X				
'Other' reasons	B	1														X				
Entity that conducted HMCFS project (not mutually exclusive), includes:																				
LEPC members or associates	B	1									X									
Contractor	B	1									X									
Federal agency	B	1									X									
'Other' entity	B	1									X									
Types of participants in most-recent HMCFS (not mutually exclusive), including:																				
Hazmat response team	B	1															X			
Hazmat incident commander	B	1															X			
Local planning agency/authority employees	B	1															X			
Local industry representatives	B	1															X			
Municipal employees	B	1															X			
County employees	B	1															X			
State employees	B	1															X			

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
Local LEPC members	B	1															X			
Volunteers	B	1															X			
Private contractor	B	1															X			
University contractor	B	1															X			
Government agency contractor	B	1															X			
'Other'–other responder-related professions	B	2															X			
'Other'–other HMCFS participants	B	2															X			
Sources of 'existing' (previously compiled) and 'new' (not previously compiled) data used for LEPC's most-recent HMCFS (not mutually exclusive), including:																				
Previous CFS for the LEPC	B	1																X		
HMCFS conducted by other LEPC, TERC, or SERC	B	1																X		
Data provided by transport carriers	B	1																X		
Data provided by local industry / fixed facilities	B	1																X		
Hazmat accident/incident data	B	1																X		
Census/Bureau of Transportation Statistics data	B	1																X		
Data provided by state agencies	B	1																X		
Data provided by federal agencies	B	1																X		
Internet sources	B	1																X		
Vehicle/vessel type counts	B	1																X		
Placard counts	B	1																X		
Interviews with local emergency responders (e.g., FD, PD, EMS, etc.)	B	1																X		
Interviews with industry representatives	B	1																X		
Interviews with transport carriers	B	1																X		

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
Shipping manifests	B	1																X		
'Other' existing data sources	B	1																X		
'Other' new data sources	B	1																X		
Informant function in LEPC (mutually exclusive), including:																				
LEPC Chair, Director, Administrator, Coordinator, etc.	B	2																	X	
Emergency Management Coordinator, Director, etc.	B	2																	X	
Other function in LEPC	B	2																	X	
Informant occupation area (not mutually exclusive), including:																				
Emergency management, emergency services, or public safety-related)	B	2																	X	
Law enforcement-related	B	2																	X	
Fire/EMS-related	B	2																	X	
HazMat-specific	B	2																	X	
Planning-related	B	2																	X	
Environmental, health, or safety-related	B	2																	X	
Communications, dispatch, or 911-related	B	2																	X	
Other occupation	B	2																	X	
Accuracy of informant's estimate of jurisdiction's population, in absolute percent difference (compared with Census data)	B	2,5																	X	
Accuracy of informant's estimate of jurisdiction's area, in absolute percent difference (compared with Census data)	B	2,5																	X	

Table F.1 continued. Variables, data sources, and variable classifications.

Variables	Type	Source	Location	Econ. Basis	Haz./Risk	Socio-Econ.	Attitude	Activity	Membership	Funding	Structure	Openness	Know./Exp.	Spanning	Motives	Resources	Participants	Information	Indiv./Role	Admin.
																				Measures
Survey participation request wave	R	2																		X
Survey distributed by SERC	B	2																		X
Survey duration	R	1																		X
Delay in survey response	R	2																		X
Survey was fully completed–informant viewed all pages	B	1																		X
Number of years since most-recent HMCFS was conducted	R	2																		X

Sources: 1) Direct response to 2008 LEPC Survey on HMCFS; 2) Calculated or interpreted from responses to 2008 LEPC Survey on HMCFS; 3) U.S. Census Bureau, 2005-2009 American Community Survey 5-Year Estimates *Table B02001. Race* and *Table B.19013. Median Household Income*; 4) http://www.city-data.com; 5) U.S. Census Bureau, Census 2000, *Table GGT-PH1. Population, Housing Units, Area, and Density: 2000* (preferred) or direct response to 2008 LEPC Survey on HMCFS; 6) Based on data from U.S. Census Bureau, Census 2000 to 2005-2009 ACS estimates; 7) USDA Economic Research Service *2004 County Typology*; 8) http://www-personal.umich.edu/~mejn/election/2008/ and http://www.usatoday.com/news/politics/election2008/president.htm; 9) Based on SERC and LEPC Web pages

APPENDIX G. COMMUNITY AND REGIONAL, LEPC ORGANIZATION, AND

SURVEY INFORMANT AND ADMINISTRATION MEASURE COMPONENTS

AND REPRESENTATIVE VARIABLES

G.1 Attitudes and Behaviors

Measure: Attitudes and Behaviors

Number of Variables:	6
# Scree Components:	3
# Eigenvalue Components:	2
% Variance in Eigenvalue Extraction:	61.832

Component	Component Percent of Variance	Variable	Loading
1	39.0%	Level of agreement that conducing HMCFS has been supported by local politicians	0.883
1	39.0%	Level of agreement that LEPC has support of local politicians	0.834
2	22.8%	2008 absolute difference between percent of jurisdiction that voted R and D for U.S. President	0.844
2	22.8%	2008 percent of jurisdiction that voted R for U.S. President	0.786

Note: only two variables with highest loadings are shown for each component

Variables included:

Percent of jurisdiction that voted Republican for U.S. President in 2008

Absolute value of difference between percent of jurisdiction that voted Republican and voted Democrat for U.S. President in 2008

Level of agreement that LEPC has support of local politicians

Level of agreement that conducting HMCFS has had support of local politicians

Level of agreement that jurisdiction's general public is interested in LEPC

Level of agreement that conducting HMCFS is important for community

G.2 Economic Basis

Measure: Economic Basis

Number of Variables:	14
# Scree Components:	2
# Eigenvalue Components:	5
% Variance in Eigenvalue Extraction:	59.503

Component	Component Percent of Variance	Variable	Loading
1	23.2%	Banking and insurance sector is major area employer	0.701
1	23.2%	Professional/medical services are major area employer	0.647
2	10.1%	Forestry or forest products is major area employer	0.659
2	10.1%	Mining or raw materials is major area employer	0.531

Note: only two variables with highest loadings are shown for each component

Variables included:

Agriculture sector is major area employer
Government agencies are major area employer
Tourism and hospitality sector is major area employer
Warehousing and distribution sector is major area employer
Non-petrochem manufacturing sector is major area employer
Forestry or forest products sector is major area employer
Mining or raw materials sector is major area employer
'Other' sector is major area employer
Petrochem industry sector is major area employer
Transportation industry or agencies are major area employer
Retail trade sector is major area employer
Banking and insurance sector is major area employer
Professional/medical services are major area employer
Educational institutions are major area employer

G.3 Hazard and Risk

Measure: **Hazard and Risk**

Number of Variables:	8
# Scree Components:	3
# Eigenvalue Components:	3
% Variance in Eigenvalue Extraction:	64.321

Component	Component Percent of Variance	Variable	Loading
1	30.9%	Jurisdiction is significant HazMat destination	0.696
1	30.9%	Jurisdiction is significant HazMat origin	0.660
2	20.7%	Level of perceived hazmat transport incident risk for roads	0.642
2	20.7%	Level of perceived hazmat transport incident risk for rail	0.530

Note: only two variables with highest loadings are shown for each component

Variables included:

Level of perceived hazmat transport incident risk for roads

Level of perceived hazmat transport incident risk for rail

Level of perceived hazmat transport incident risk for pipeline

Level of perceived hazmat transport incident risk for waterway

Jurisdiction is significant HazMat origin

Jurisdiction is significant HazMat destination

Significant HazMat is transported within jurisdiction

Significant HazMat is transported through jurisdiction

G.4 Socio-Economic Demographics

	Measure:	Socio-Economic Demographics	
		Number of Variables:	14
		# Scree Components:	4
		# Eigenvalue Components:	4
		% Variance in Eigenvalue Extraction:	64.491

Component	Component Percent of Variance	Variable	Loading
1	24.5%	Percent of population that has attended at least some college or more beyond high school	0.816
1	24.5%	Natural log of jurisdiction population	0.714
2	21.3%	Transformation of percent population that is White	0.654
2	21.3%	Housing stress county indicator	0.651

Note: only two variables with highest loadings are shown for each component

Variables included:

Diversity of different major area employer groups
Natural log of jurisdiction area
Natural log of jurisdiction population
Natural log of jurisdiction population density
Population growth (from Census 2000 to 2005-2009 ACS estimates)
Transformation of percent population that is White (higher value is lower percentage)
CLI-adjusted median household income ('05-'09 average)
Percent of population that has attended at least some college or more beyond high school
Housing stress county indicator
Low-education county indicator
Low-employment county indicator
Persistent poverty county indicator
Population loss county indicator
Persistent child poverty county indicator

G.5 Organization Activity

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Measure: **Organization Activity**

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	Number of Variables:	5
	# Scree Components:	4
	# Eigenvalue Components:	2
	% Variance in Eigenvalue Extraction:	56.808

Component	Component Percent of Variance	Variable	Loading
1	31.0%	Number of different LEPC participant groups	0.762
1	31.0%	Frequency of LEPC formal meetings	0.638
2	25.8%	Frequency that LEPC members communicate specifically about HMCFS	0.759
2	25.8%	Number of times LEPC conducted HMCFS	0.687

Note: only two variables with highest loadings are shown for each component

Variables included:

Frequency LEPC members communicate specifically about the HMCFS

Frequency of LEPC meetings

Attendance at last LEPC meeting

Number of times LEPC has conducted HMCFS

Number of different participant groups

G.6 Organization Boundary Spanning

Measure: Organization Boundary Spanning

Number of Variables:	15
# Scree Components:	2
# Eigenvalue Components:	6
% Variance in Eigenvalue Extraction:	59.455

Component	Component Percent of Variance	Variable	Loading
1	17.0%	Email used as primary communication mode in LEPC	0.603
1	17.0%	LEPC has ever asked another LEPC for a copy of their HMCFS	0.602
2	10.0%	Motivation: Communities/regional planning agencies requested HMCFS	0.710
2	10.0%	Face to face meetings used as primary communication mode	0.679

Note: only two variables with highest loadings are shown for each component

Variables included:

Number of different LEPC participant groups

Frequency that LEPC members communicate specifically about HMCFS

Frequency of SERC communication with LEPC about conducting HMCFS

Percent of responding LEPCs by State that conduct CFS

LEPC has been asked by another LEPC for a copy of HMCFS

LEPC has asked another LEPC for a copy of their HMCFS

Email used as primary communication mode in LEPC

Phone used as primary communication mode in LEPC

Face to face meetings used as primary communication mode in LEPC

Regular formal scheduled meetings used as primary communication mode in LEPC

Informal meetings used as primary communication mode in LEPC

Other means used as primary communication mode in LEPC

Motivation: LEPC became aware that other LEPCs had conducted CFS

Motivation: Communities/regional planning agencies requested HMCFS

Motivation: SERC suggested LEPC conduct a CFS

G.7 Organization Funding

		Measure:	**Organization Funding**	
			Number of Variables:	10
			# Scree Components:	3
			# Eigenvalue Components:	4
			% Variance in Eigenvalue Extraction:	74.148

Component	Component Percent of Variance	Variable	Loading
1	30.5%	Natural log of 2007 total LEPC funding per thousand population	0.900
1	30.5%	Number of funding sources received in 2007	0.882
2	18.3%	Natural log of amount of non-local funding for most-recent HMCFS per thousand population	0.827
2	18.3%	Number of non-local funding sources used for most-recent HMCFS	0.800

Note: only two variables with highest loadings are shown for each component

Variables included:

Received funding from some source in 2007

Number of funding sources received in 2007

Natural log of 2007 total LEPC funding per thousand population

Agreement whether LEPC has the resources it needs to do its job

Number of non-local funding sources used for most-recent HMCFS

Natural log of amount of non-local funding for most-recent HMCFS per thousand population

Funding is primary barrier for conducting HMCFS

Motivation: Funding availability

Participant involvement: Budget to hire contractor unavailable

Participant involvement: Contractor available and affordable

G.8 Organization Knowledge and Experience

	Measure:	Knowledge and Experience	
		Number of Variables:	19
		# Scree Components:	3
		# Eigenvalue Components:	8
		% Variance in Eigenvalue Extraction:	60.641

Component	Component Percent of Variance	Variable	Loading
1	15.2%	LEPC has ever asked another LEPC for a copy of their HMCFS	0.662
1	15.2%	Other HMCFS examples used to guide HMCFS	0.579
2	8.3%	Contractor knowledge/experience with process used to guide HMCFS	0.698
2	8.3%	Technical capability not locally available	0.511

Note: only two variables with highest loadings are shown for each component

Variables included:

Number of times LEPC has conducted HMCFS

Other HMCFS examples used to guide HMCFS

Knowledge within LEPC membership used to guide HMCFS

Other: Prior experience with HMCFS or personal knowledge used to guide HMCFS

Contractor knowledge/experience with process used to guide HMCFS

US DOT "Guidance" used to guide HMCFS

HMEP Grant Program guidance used to guide HMCFS

Instructions from SERC or PHMSA used to guide HMCFS

Census/BTS guidance/documents used to guide HMCFS

TRANSCAER Manual used to guide HMCFS

Other: State or federal document or instruction used to guide HMCFS

LEPC understanding of HMCFS process

Percent of responding LEPCs by State that conduct CFS

LEPC has been asked by another LEPC for a copy of HMCFS

LEPC has asked another LEPC for a copy of their HMCFS

Motivation: LEPC became aware that other LEPCs had conducted CFS

Motivation: LEPC thought it a good way to get a handle on hazmat flows

Participant involvement: Local community has the technical capability

Participant involvement: Technical capability not locally available

G.9 Organization Membership

	Measure:	**Organization Membership**	
		Number of Variables:	15
		# Scree Components:	2
		# Eigenvalue Components:	5
		% Variance in Eigenvalue Extraction:	54.408

Component	Component Percent of Variance	Variable	Loading
1	22.3%	Transport carriers participate in LEPC	0.588
1	22.3%	Environmental groups participate in LEPC	0.572
2	9.4%	Other group representatives participate in LEPC	0.675
2	9.4%	TRANSCAER representatives participate in LEPC	0.560

Note: only two variables with highest loadings are shown for each component

Variables included:

Fire department officials participate in LEPC
Emergency managers participate in LEPC
Transportation carriers participate in LEPC
Police/sheriff department officials participate in LEPC
TRANSCAER representatives participate in LEPC
Social/community activists participate in LEPC
State officials participate in LEPC
Public works officials participate in LEPC
Public health/EMS/hospital officials participate in LEPC
Other group representatives participate in LEPC
Industry representatives participate in LEPC
Hazardous materials teams participate in LEPC
Environmental groups participate in LEPC
Local elected officials participate in LEPC
Media representatives participate in LEPC

G.10 Organization Motives

Measure: **Organization Motives**

Number of Variables:	7
# Scree Components:	2
# Eigenvalue Components:	4
% Variance in Eigenvalue Extraction:	64.625

Component	Component Percent of Variance	Variable	Loading
1	18.4%	Motivation: LEPC thought it a good way to get a handle on hazmat flows	-0.786
1	18.4%	Motivation: Communities/regional planning agencies requested it	0.589
2	16.1%	Other Motivation: LEPC planning activities including plan updates	-0.701
2	16.1%	Motivation: SERC suggested LEPC conduct HMCFS	0.663

Note: only two variables with highest loadings are shown for each component

Variables included:

Motivation: LEPC thought it a good way to get a handle on hazmat flows

Motivation: LEPC planning activities including plan updates

Motivation: Communities/regional planning agencies requested it

Motivation: SERC suggested LEPC conduct a CFS

Motivation: An influential hazmat community stakeholder championed it

Motivation: LEPC became aware that other LEPCs had conducted CFS

Motivation: Funding availability

G.11 Organization Resource Access

	Measure:	**Organization Resource Access**	
		Number of Variables:	9
		# Scree Components:	4
		# Eigenvalue Components:	4
		% Variance in Eigenvalue Extraction:	63.025

Component	Component Percent of Variance	Variable	Loading
1	20.8%	Participant involvement: Local community staff time was available	0.685
1	20.8%	Participant involvement: Contractor available and affordable	-0.638
2	17.1%	Participant involvement: Budget to hire contractor unavailable	0.670
2	17.1%	Participants were involved in HMCFS for other reasons	-0.539

Note: only two variables with highest loadings are shown for each component

Variables included:

Participant involvement: Local community has the technical capability

Participant involvement: Local community staff time was available

Participant involvement: State resources were available

Participant involvement: Technical capability not locally available

Participant involvement: Local community staff time not available

Participant involvement: Budget to hire contractor unavailable

Participant involvement: Contractor available and affordable

Participant involvement: Industry personnel were made available

Participants were involved in HMCFS for other reasons

G.12 Survey Informants

Measure: Survey Informants

		Number of Variables:	13
		# Scree Components:	2 or 3
		# Eigenvalue Components:	6
		% Variance in Eigenvalue Extraction:	68.412

Component	Component Percent of Variance	Variable	Loading
1	16.1%	Informant has other function in LEPC	0.893
1	16.1%	Informant is LEPC Chair, Director, Administrator, Coordinator, etc.	-0.861
2	12.9%	Informant has emergency management, emergency services, or public safety related occupation	-0.831
2	12.9%	Informant is Emergency Management Coordinator, Director, etc.	-0.520

Note: only two variables with highest loadings are shown for each component

Variables included:

Informant is LEPC Chair, Director, Administrator, Coordinator, etc.

Informant is Emergency Management Coordinator, Director, etc.

Informant has other function in LEPC

Informant has emergency management, emergency services, or public safety related occupation

Informant has law enforcement related occupation

Informant has fire/emergency medical services related occupation

Informant has HazMat-specific related occupation

Informant has planning related occupation

Informant has environmental, health, or safety related occupation

Informant has other occupation

Informant has communications, dispatch, or 911 related occupation

Accuracy of informant population estimate

Accuracy of informant area estimate

G.13 Survey Administration

	Measure:	Survey Administration	
		Number of Variables:	5
		# Scree Components:	2
		# Eigenvalue Components:	3
		% Variance in Eigenvalue Extraction:	72.299

Component	Component Percent of Variance	Variable	Loading
1	24.2%	Survey participation request was distributed by SERC	0.867
1	24.2%	Survey participation request wave	0.677
2	21.7%	Number of years since most recent HMCFS was conducted	0.656
2	21.7%	Natural log of survey response delay	0.607

Note: only two variables with highest loadings are shown for each component

Variables included:

Survey participation request wave

Distribution method of survey

Natural log of survey response delay (hours)

Survey was fully completed

Number of years since most recent HMCFS was conducted

APPENDIX H. MULTIPLE LINEAR REGRESSION

AND BINOMIAL LOGISTIC REGRESSION

H.1 Multiple Linear Regression

Multiple linear regression (MLR) is a commonly used technique for identifying linear relationships between dependent variables and one or more independent variables. It is also sufficiently robust to provide good approximations even when relationships between variables are not linear. A general form of the MLR equation is $y = a + b_1x_1 + b_2x_2 + \ldots + \varepsilon$ where y is the dependent variable, a is a constant, the b_is are the regression coefficients associated with each independent variable x_i, and ε is a disturbance (error) term. The multiple correlation coefficient, R^2, is a goodness-of-fit measure which indicates the amount of variance of the dependent variable that is explained by the model of specified independent variables.

Any type of independent variable can be included in a MLR model, provided the inclusion of those variables does not violate key assumptions, which will be discussed below. MLR is best suited to continuous dependent variables, and ideally these variables are unbounded. However, ordinal dependent variables are sometimes analyzed using MLR (DeMaris, 2005) under the assumption that a one-unit increase in the dependent variable is approximated by ordinal levels (P. D. Allison, 1999). Thus, multiple linear regression has strengths in that it is simple, widely understood, applied and accepted, and can be used for a variety of dependent variables (albeit not ideally for dichotomous variables).

The MLR assumption of linearity refers to the condition that the dependent variables are linear functions of the independent variables, plus a random disturbance error term. However, for most assessments, the assumption of linearity is only "approximately true" (P. D. Allison, 1999). Independence of the mean refers to the idea that no matter the values of the dependent variables, they are not related to the random error inherent to the estimation. It is the most critical of all assumptions (P. D. Allison, 1999) and can be violated in three ways. One of these is improper specification— omitted independent variables that affect the dependent variable, and correspondingly, random error associated with the omitted variables will be attributed to the variables included in the model. Unfortunately, identifying all potential independent variables that could affect dependent variables is practically impossible. Another potential problem is recursivity, or reverse causation, if the dependent variable has a causal effect on any independent variable. Finally, if there is error in measuring the independent variables, then that error become part of the estimation's random error.

Homoscedasticity refers to the consistency of the random error in linear equations over the range of independent variables. If the random error is inconsistent over the range of x_i variables, the data is heteroscedastic. Outliers "are a form of violation of homoscedasticity … [that] are cases representing high residuals (errors) which are clear exceptions to the regression explanation" (Garson, 2006, Homoscedasticity section, ¶ 4). Consequences of having heteroscedasticity include inefficiency of multiple linear regression versus other analysis techniques, and bias of standard errors and test statistics, a more serious problem. Heteroscedasticity of models

can be checked using plots of standardized residual errors. If heteroscedasticity is found, a model can be respecified, weighted least squares and robust standard errors analysis can be used, or the dependent variable can be transformed to stabilize the variance through logarithmic or square functions, as necessary.

Since every case in a sample has its own random error, there can be no correlation between the error terms for any two cases, that is, they are independent. Correlated errors can result when two individuals share the same characteristics, for example, location. This can also occur over time when the same person is measured at multiple times in longitudinal studies. The result will typically be inflated test statistics because the standard errors are usually inflated downward.

The normality assumption requires that the error term be normally distributed over the sample. It does not require normal distribution of the dependent or independent variables. When sample sizes are sufficiently large (over 100), the normality assumption becomes less of a concern. Normality of the disturbance term will be checked by examining the normality of a residuals plot and associated normality tests (Allison, 1999).

Extreme or near-extreme multicollinearity occurs when two or more independent variables have a perfect or near-perfect linear relationship. Extreme multicollinearity results in the inability to identify a specific regression solution, and can occur with interval data that in-effect measure the same thing, or when dummy variables for all levels of a categorical variable are included as independent variables (Garson, 2006). Near extreme multicollinearity occurs when two or more independent variables have a

very strong linear relationship that is not perfect. Although this does not change the coefficient estimates that are generated in the regression, it does inflate the standard errors of those coefficients and as a result reduces the reliability of coefficient estimates, that is, the ability to identify their importance and significance.

One way multicollinearity can be identified is by using a correlation matrix where significant correlations of .6 or larger suggest potential problems of multicollinearity (P. D. Allison, 1999). In addition, the tolerance and variance inflation factors (VIF), which are reciprocals of each other, can be examined as diagnostic statistics, Allison (1999) suggests a permissible VIF of 2.5 for independent variables, while Garson (2011b) indicates that a VIF value of 4 (corresponding to a doubling the standard error of the b coefficient in ordinary least squares regression) is acceptable for most social science research.

Solutions to multicollinearity problems include removing problem variables from the model specification, development of an index that combines highly collinear variables, substituting a latent variable in the specified model that affects the collinear variables, or performing joint hypothesis tests separately for each of the collinear independent variables. Allison concludes that "the only real solution to the problem of multicollinearity is to get better data. Simply increasing the sample size can help a great deal … [since it] will reduce the inflated standard errors that stem from multicollinearity … even better is to somehow get data in which the variables are not collinear" (1999, p. 149). Garson (2006) lists unbounded data and data that are not censored, sample selected, or truncated as additional assumptions for multiple linear regression models.

H.2 Logistic Regression Models

Generalized Linear Models (GLZM) that utilize logit-based link functions include logistic regression models. By using a model based on the logit, or log of the odds ratio, where the odds ratio equals $\pi/(1-\pi)$, the model value can now vary between $-\infty$ and $+\infty$, while π varies from 0 to 1.

The logistic regression model form is $\ln(\pi/(1-\pi)) = \alpha + \beta x$, where $\ln(\pi/(1-\pi))$ is referred to as the logit(π). For any one unit change in the independent variable being measured from a reference category, the odds ratio changes by e^β. The odds ratio and knowledge of the base probabilities of reference categories can be used to identify probabilities for a variable of interest. The logistic regression model is similar to the multiple linear regression model in that a) the logit coefficients β correspond to the slope coefficients b from multiple linear regression; b) standardized logit coefficients correspond to beta weights in multiple regression models that allow comparison of the predictive importance of independent variables; and c) interaction of independent variables can be included in the model. (P. D. Allison, 1999; Garson, 2006).

As with multiple linear regression, effective use of logistic regression approaches requires independence of observations, that variables are appropriately and meaningfully specified to minimize measurement error, that missing data are minimized, and irrelevant variables should be excluded. Logistic regression also has differences from linear regression models. A primary reason that researchers use logistic regression is that such models do not assume a normal distribution of the error term over the sample, and do not assume homoscedasticity of the dependent and independent variables.

However, logistic regression models can also be more complicated to interpret than multiple linear regression models since estimates are of log-based transforms of the dependent variable that incorporates odds (the log of the odds ratio), which can then be used to determine expected changes in the dependent itself. Multiple linear regression models are simpler in that the estimated changes are calculated for the dependent itself. Also, while R^2 statistics in linear regression models are used as indicators of the percent of variance explained in the dependent variable, such statistics are not available in SPSS logistic regression models. Rather, Pseudo R^2 statistics can be interpreted as indicators of effect size along with crosstabulation categorization tables. Values of around .1 for Cox and Snell and Nagelkerke Pseudo R^2 statistics are considered as being a weak indicator of effect size, but this does not imply that results are not significant (Garson, 2011c). Logistic regression models cannot be used for continuous dependent variables, while linear regression models can.

Although logistic regression does not assume a linear or approximately linear relationship between the dependent and independent variables, it does assume a linear relationship between the logit of the dependent variables and continuous independent variables (Garson, 2011b).

Disturbance (error) terms are also assumed to be independent, with violations potentially occurring in clustered or longitudinal data – more specialized regression models can be used if this assumption is not met. Although homoscedasticity is not a necessary assumption, outliers can substantially affect results in logistic regression, and can be checked by examining standardized residuals plots.

Logistic regression models must be well-fitting. This can be evaluated using a Test of Parallel Lines in ordinal logistic regression and the Hosmer and Lemeshow Chi-Square Test in binomial logistic regression, where nonsignificant test statistics indicate well fitting models. Other tests available in both ordinal and binomial logistic regression are -2 Log Likelihood (-2LL) and Pearson-Deviance Goodness-of-Fit tests, where significant test statistics are indicators of a good model fit. It is important to note that the Pearson-Deviance Goodness of Fit test is not reliable test when cell sizes are inadequate or linear covariates are used.(Garson, 2011c)

Perfect or high multicollinearity and outliers must be avoided. Garson (2006, 2011b) also identifies that the expected dispersion of the dependent variable's variance should be compared with that of the observed variance. Discrepancies in standard errors may require wider estimates of confidence intervals, respecification of the model, or consideration that the model has more serious underlying problems.

Similar to multiple linear regression, the use of standardized regression coefficients in binomial logistic regression allows the researcher to identify the relative importance of variables in the regression equation. However, standardized logistic regression coefficients are not calculated in some commercial statistical software packages, including SPSS 20.0. Alternate means of calculating standardized logistic regression coefficients include partially standardized coefficients (King, 2007; Menard, 2004, 2011) which enable the researcher to identify a rank importance of different variables within the same regression equation and sample. However, this approach has important limitations in that it is not comparable to standardized regression coefficients

calculated for multiple logistic regression models, and is not useful for comparing coefficients across regression models or samples (Menard, 2004, 2011).

An approach that provides a standardized coefficient for logistic regression which is more comparable to that of multiple linear regression is described by Menard (2004, 2011). In this approach, the standardized logistic regression coefficients are calculated according to the following equation:

$$b^*_M = b(s_X)R/s_{logit(\hat{Y})}$$

where b^*_M is the standardized logistic regression coefficient, b is the unstandardized logistic regression coefficient, s_X is the standard deviation of independent variable X, R is the correlation between observed values of dependent variable Y and predicted values of Y, and $s_{logit(\hat{Y})}$ is the standard deviation of $logit(\hat{Y})$, and $logit(\hat{Y}) = b_0 + b_1 X_1 + b_2 X_2 + \ldots + b_n X_n$.

The following procedure can thus be used to calculate b^*_M for logistic regression equations using SPSS 20.0 statistical software:

1) Calculate s_X, the standard deviations of each independent variable that is included in logistic regression equations.

2) Calculate b, unstandardized logistic regression coefficients for each independent variable included in each logistic regression model.

3) Calculate R, the correlation between observed values of dependent variable Y and the predicted values of Y from logistic regression models.

4) Calculate logit $(\hat{Y})$ for each case using unstandardized regression coefficients and actual case values for independent variables included in logistic regression models.

5) Calculate $s_{logit(\hat{Y})}$, the standard deviation of logit $(\hat{Y})$ from step 4 above.

6) Calculate b^*_M using values calculated in steps 1, 2, 3, and 5 above.

APPENDIX I. THREATS TO VALIDITY

I.1 Statistical Conclusion Validity

Threats to statistical conclusion validity refer to whether the inferences of statistical relationships between a variable and its outcome—for this research, HMCFS information selection—are valid. Low statistical power is one such threat. For this research, the sample size (n = 183) was reduced from that potentially available due to completeness of responses for key dependent and independent variables and the level of informant knowledge about the project. This reduces the statistical power, but increases the reliability of the measures. Truncation of measurement range was avoided as practicable.

Another potential validity threat is that informants did not understand survey instructions, or had differing interpretations of response options. While it is not possible to ascertain the degree this occurred, the survey instrument was written in language and terminology that is common to the LEPC and emergency planning context. The survey instrument was also pretested at a conference of LEPC stakeholders and improved to address potential issues with survey questions. Responses were also excluded for cases in which the informant indicated they were not involved with the project or had excessive responses that they 'didn't know' the answer.

Some responses were ordinal in nature. When possible, an interval measure of these variables was also evaluated for statistical relationships. For example, the frequency of formal LEPC meetings was measured on an eight-level ordinal scale, and

also using a numerical approximation that was included with the ordinal scale in the survey instrument: between 'Never (Inactive)' and 'Weekly (40 to 52 times a year)'.

Heterogeneity of units was accounting for by evaluating only responses from LEPCs that had conducted an HMCFS. Factors that could account for differences across LEPCs were also controlled for, such as state or region, peer activity, and social, environmental, and economic characteristics. While it is assumed that responses were provided from an LEPC's organizational perspective, it is recognized that individual informant characteristics, such as their role in the LEPC organization or professional background, could influence their responses. These factors were also accounted for in the statistical analysis.

The potential for inaccurate effect size was considered by examining variable distributions for outliers. To reduce the influence of truncated ranges in the dependent variable, results were first evaluated using multiple linear regression on the ordinal form of the dependent variable, and those results were confirmed using binomial logistic regression on the binary form of the dependent variable.

I.2 Internal Validity

Threats to internal validity refer to whether influences between an independent variable and a dependent variable reflect a causal relationship. While it is not possible to statistically test causality in a cross-sectional study, as with this research, the independent variables were carefully evaluated based on their conceptual hierarchies and grouped in sets (Cohen, et al., 2003), and then evaluated in order from those that are theoretically more-distal from the dependent variable to those that are more-proximal to

the dependent variable. Variables for which a hierarchical order could not be theoretically justified were grouped in the same set. Using this approach, the amount of unique variance that is attributable to each variable, or sets of variables, can be more-readily identified.

The hierarchical ordering speaks to challenges of ambiguous temporal precedence. For most variables this is not a significant concern. However, some variables need to be considered for this threat. For example, the survey asked informants to indicate the level of political support for the LEPC and for conducting HMCFS. The hierarchical ordering of these variables presumes they are antecedent to the way that the HMCFS was conducted, including their effects on those who were involved and the information sources that were selected. However, since the survey measured these variables for each response at a single point in time, after the HMCFS was conducted, it is possible that the way the HMCFS was conducted had a causal effect on the perceived political support for the LEPC and the HMCFS, and these effects are what were actually measured. To the extent that such variables are statistically significant in modeled outcomes, they will be noted in discussion of the results.

The selection of informants is an inherent concern for self-selected survey research, and this study is no exception. Effects of early and late survey informants were accounted for by including the wave of survey responses and the duration of time between survey participation requests and survey responses. Effects of self-selection were also accounted for by including the informant's role in the LEPC organization, in that the organization's self-selected informants might have a leadership role in the

organization, or some other type of non-leadership role, which may have affected their responses.

History effects were also considered. For example, a particularly important event that was a watershed in the recent history of emergency planning was the terrorist attacks in New York, Washington, D.C., and Pennsylvania on September 11, 2001. A concern might be that HMCFS conducted before this date had different priorities than those conducted after that date. However, there was no statistically significant correlation between whether or not an HMCFS that was conducted in 2001 (which would likely have concluded in September of that year since most studies that have federal funding, as many of these do, operate on a federal fiscal calendar) or before, and HMCFS information selection dependent variables or HMCFS participant independent variables. The number of years since the most recent HMCFS was conducted was also included to identify any systematic historical changes in project outcomes with respect to time to account for maturation effects or memory bias.

Some informants failed to provide responses for all survey questions, and only completely specified cases were included in the regression models (using listwise deletion). This addresses attrition threats, but limits the number of cases available for the model. In general, there was a 15 to 20 percent reduction of cases in full regression models due to attrition. For variables with higher response attrition, such as those for LEPC resources and HMCFS project resources which had attrition rates as high as 40 or 50 percent, they were considered as a separate analysis only after models were specified using other variables with more complete response rates. Models were also evaluated

using imputation of mean values for missing data to maximize the number of available cases. These results (not presented in this dissertation) did not appreciably change the direction of regression coefficients, and for the most part did not change significance of relationships, while the proportion of variance explained for the imputed data regression models was reduced, as would be expected.

With respect to testing biases, one survey version was administered, but multiple responses were received from a few agencies. Most of these were partial responses that were later restarted, others were from multiple persons at the same agency. In these cases, the most complete responses were used. In the very few cases of completed responses from multiple persons in the same agency, the response from the most-senior individual in the agency was used.

With respect to evaluation apprehension, informants may have altered their responses if they had an expectation they might receive grant funding or wanted to project a certain image of their organization. Without contacting each informant, it would be difficult to identify whether evaluation apprehension occurred in informants. However, as noted above, informant role in the LEPC organization was accounted for which may be related to evaluation apprehension effects.

I.3 Construct Validity

Threats to construct validity involve the ability of "making inferences from the sampling particulars of a study to the higher-order constructs they represent" (Shadish, et al., 2002). In other words, the concern is how well the study measures what needs to be measured in order to make inferences about research outcomes.

An important consideration for this research is measurement of constructs for the dependent variables, which are truncated ordinal level scales for information selection. A review of free-form responses to information source questions suggests there was not a general failure to obtain information about important HMCFS information sources through the design of the survey instrument. However, it is possible that the measures could have been better specified to more accurately reflect the nature of the dependent variable. For example, in the survey instrument, informants could indicate that interviews with industry representatives were an information source, but the question does not specify the nature of interviews that were conducted (short or long, structured or unstructured, in-person or by phone, etc.) or the sector of the industry representatives who were interviewed (petrochemical manufacturing, non-petrochemical manufacturing, mining and raw materials, etc.). As almost always there is a tradeoff between the data that are available (or the time and means by which a research study has at its disposal to obtain the data they are interested in), and data that are obtainable. These considerations are important to keep in mind for interpretation of research results and further research investigations.

Responses may also have been confounded for similar types of organizations. For example, when indicating that interviews with HMCFS emergency responders was an information source, survey informants may have had biases for interview information with particular types of agencies (e.g., paid fire departments versus volunteer fire departments, city police departments versus sheriff's offices, etc.) as opposed to others.

With respect to mono-operation bias, this research examines the conduct of HMCFS in LEPCs, not all emergency planning activities in all types of local emergency planning agencies. Responses are assumed to represent LEPCs that conduct HMCFS at a national level. However, in practice LEPCs in different states may have different resources available, different planning protocols and requirements, etc. This is accounted for by including state and regional measures for both location and peer activity in the conduct of HMCFS.

Reactivity to the experimental situation is another potential validity threat. Responses may have been provided that the informants thought were expected of them. An example might be an indication by informants that certain types of data were used for a HMCFS project, when in fact they were not. Unfortunately it is difficult to account for this bias aside from expensive and time-consuming follow-up with individual informants, or control of survey administration in specific settings, which is impractical for an electronically administered national survey.

I.4 External Validity

Threats to external validity refer to whether statistical relationships between variables are generally applicable beyond the research focus area. For this research, external validity affects whether results are valid only for LEPCs that conduct HMCFS, for all LEPCs in the U.S., for emergency planning agencies or planning agencies in general, or local governmental organizations. In assessing the potential effects of causal relationships with the research units (LEPCs), it is important to keep in mind that a) the overall survey was a sample of the known population of LEPCs 38 states in the

Continental U.S. with additional responses from LEPCs in 6 states; and b) the sample for this research is comprised of self-selected informants whose LEPCs had conducted an HMCFS.

Unfortunately it is difficult to ascertain the number of LEPCs that conduct or have conducted HMCFS. According to PHMSA (2011a) the HMEP Grants Program has funded over 9,000 HMCFS since the beginning of the program (in the 1990s), and funded 434 commodity flow and hazard analyses in the latest reporting period (a recent federal fiscal year, although it is unclear exactly which year this is applicable to). The exact number of LEPCs is unclear—Starik et al. (2000) refer to over 4,100 known LEPCs in the U.S. while the U.S. EPA (2009a) refers to more than 3,000 LEPCs of which 2,357 were identified as having valid e-mail addresses. Under the assumption that between 2,000 and 2,500 LEPCs are at least minimally active in a given year, this means that one out of every five LEPCs is conducting a commodity flow or hazardous analyses on an annual basis using PHMSA's program information, and one out of every ten is conducting an HMCFS if this proportion is split between the two types of studies. This appears to be a very optimistic level of level activity for HMCFS. For LEPCs, conducting an HMCFS is a voluntary, not mandatory part of annual emergency planning requirements. That an LEPC takes the time and effort to conduct an HMCFS is an indicator of an organization that is more proactive in their planning activities, at least in the sense they are doing beyond the minimum required to be 'getting by.' This is an important consideration for interpretation and generalization of research results.

HMCFS participants are essentially the treatment in this research. Even considering the various roles that planners can take in planning processes—coordinators, facilitators, advisors, advocates, etc.—in the LEPC and HMCFS context, community planners are <u>participants</u> in the planning process—and specifically for this research, in the selection of planning information. HazMat responders are also a treatment in this research design. While their role in the context of HMCFS for this study is also as participants in the planning process, emergency responders are considered to be a key stakeholder in local emergency planning and have a high degree of involvement, and sometimes coordination, of the emergency planning processes. However, this role does not typically extend to community planning processes outside their areas of specialization. These varying roles are considered in the evaluation of research results.

Another threat to construct validity is whether the effect of the treatments and outcomes measured in this research are generalizable to different outcomes. For example, the effect of HMCFS participants on selection of technical and communicative information sources was measured, but do the effects apply to other technical or communicative information sources that may be potentially available (even if free-form questions did not suggest additional information sources), or other types of information sources such as non-local information or previous studies? These types of questions should be considered as potential areas for further research.

This research included an array of social, environmental, and economic measures at local, state, and regional levels to account for biases of different settings. However, responses were received from LEPCs in 42 of the 48 Continental U.S. states, and

identified relationships may not hold for LEPCs in the other Continental U.S. states or in

Alaska, Hawaii, or U.S. territories. In a similar way, research results that indicate an

effect of HMCFS participants (or other variables) on HMCFS information selection may

be applicable to LEPCs, but their application to other settings, such as tribal emergency

response commissions, may be very different. This context-dependent validity threat is

similar to those exhibited for interaction of causal relationships with research units.

APPENDIX J. CORRELATION ANALYSIS

J.1 Correlation Analysis

Zero-order pairwise correlations are presented for each of the variables considered in the regression analyses for this research. The correlation matrix tables are presented in blocks since the total number of variables (38) precludes listing all of them in a single table. The correlations in the matrices are listed for the type of correlation appropriate to the form of variable— Pearson's r for interval and ratio variables, Spearman's rho for ordinal-ordinal or ordinal-binary comparisons, and Phi for binary-binary comparisons.

Table J.1. Correlation matrix one for variables included in research analysis.

Variable ID and Description		1	2	3	4	5	6	7	8	9	10	11	12
1	Communicative information selection (O)	Value	1											
		Sig.												
		N	183											
2	Communicative information selection (B)	Value	$.947^{**}$	1										
		Sig.	.000											
		N	183	183										
3	Number of selected HMCFS information sources	Value	$.565^{**}$	$.398^{**}$	1									
		Sig.	.000	.000										
		N	173	173	173									
4	Number of selected HMCFS information types	Value	$.448^{**}$	$.462^{**}$	$.784^{**}$	1								
		Sig.	.000	.000	.000									
		N	173	173	173	173								
5	Local planning agency/authority employees participated in HMCFS (B)	Value	$.219^{**}$	$.179^{*}$	.133	$.162^{*}$	1							
		Sig.	.003	.016	.081	.033								
		N	183	183	173	173	183							
6	HazMat responders participated in HMCFS (B)	Value	.132	.117	.080	.017	$.189^{*}$	1						
		Sig.	.075	.116	.293	.826	.011							
		N	183	183	173	173	183	183						
7	Diversity of HMCFS Participants (R)	Value	$.290^{**}$	$.224^{**}$	$.310^{**}$	$.225^{**}$	$.468^{**}$	$.508^{**}$	1					
		Sig.	.000	.002	.000	.003	.000	.000						
		N	183	183	173	173	183	183	183					
8	Frequency of LEPC formal meetings (times/year) (R)	Value	-.049	-.038	-.063	-.017	.109	.036	.101	1				
		Sig.	.506	.606	.407	.821	.143	.631	.173					
		N	183	183	173	173	183	183	183	183				
9	Square root of number of years in which LEPC has conducted HMCFS (R)	Value	.013	.014	$.189^{*}$	$.237^{**}$	$-.153^{*}$	.102	.122	-.066	1			
		Sig.	.862	.851	.013	.002	.039	.170	.101	.374				
		N	183	183	173	173	183	183	183	183	183			

Table J.1 continued. Correlation matrix one for variables included in research analysis.

	Variable ID and Description		1	2	3	4	5	6	7	8	9	10	11	12
10	LEPC has ever asked another LEPC for a copy of their HMCFS (B)	Value	.171[*]	.155[*]	**.337**[**]	**.449**[**]	-.003	-.001	.136	.112	.032	1		
		Sig.	.025	.042	.000	.000	.973	.986	.076	.143	.680			
		N	172	172	162	162	172	172	172	172	172	172		
11	Primary reason for CFS: Communities/regional planning agencies requested it (B)	Value	.041	.042	.047	.096	.153[*]	.125	.155[*]	-.001	.237[**]	-.114	1	
		Sig.	.582	.568	.539	.209	.039	.092	.036	.994	.001	.135		
		N	183	183	173	173	183	183	183	183	183	172	183	
12	Natural log of total LEPC budget in 2007 per thousand population (R)	Value	.042	.074	.190	.179	-.037	-.024	-.035	.177	.019	.223[*]	-.123	1
		Sig.	.681	.473	.067	.085	.720	.812	.737	.082	.853	.028	.230	
		N	97	97	94	94	97	97	97	97	97	97	97	97

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table J.2. Correlation matrix two for variables included in research analysis.

	Variable ID and Description		1	2	3	4	5	6	7	8	9	10	11	12
13	Natural log of amount of non-local funding for most-recent HMCFS per thou. pop. (R)	Value	.095	.012	.307**	.249**	.059	.004	-.005	.035	-.037	.207*	-.169*	.150
		Sig.	.268	.886	.000	.004	.489	.965	.956	.686	.667	.016	.047	.201
		N	138	138	129	129	138	138	138	138	138	136	138	74
14	Other HMCFS examples were used to guide HMCFS (B)	Value	.119	.089	.299**	.390**	-.019	.000	.087	-.047	.083	.380**	-.033	-.059
		Sig.	.113	.236	.000	.000	.802	1.000	.245	.528	.271	.000	.657	.570
		N	180	180	172	172	180	180	180	180	180	169	180	96
15	Contractor knowledge/ experience with process was used to guide HMCFS (B)	Value	.060	.051	.119	.039	.019	.007	.046	.133	.023	.061	-.028	.069
		Sig.	.421	.495	.121	.610	.800	.922	.537	.076	.757	.428	.705	.505
		N	180	180	172	172	180	180	180	180	180	169	180	96
16	Transportation carriers participate in LEPC (B)	Value	.045	.014	.116	.010	.017	.205**	.240**	.052	-.071	.083	-.099	.095
		Sig.	.567	.860	.148	.900	.830	.008	.002	.510	.366	.290	.205	.355
		N	164	164	157	157	164	164	164	164	164	164	164	97
17	'Other' group representatives participate in LEPC (B)	Value	-.036	-.046	.051	-.022	-.080	-.067	-.077	-.027	.021	-.137	-.001	.125
		Sig.	.649	.560	.523	.787	.308	.395	.330	.732	.787	.081	.989	.221
		N	164	164	157	157	164	164	164	164	164	164	164	97
18	Primary reason for CFS: The HMCFS seemed a good way to get a handle on hazmat flows (B)	Value	.057	.059	.151*	.170*	-.124	.041	-.027	.076	.149*	.209**	-.208**	.073
		Sig.	.446	.424	.048	.025	.094	.581	.718	.307	.044	.006	.005	.477
		N	183	183	173	173	183	183	183	183	183	172	183	97
19	Primary reason for CFS: SERC suggested LEPC conduct a CFS (B)	Value	-.028	-.049	.001	-.040	.095	.104	.054	-.048	.093	-.025	.001	-.012
		Sig.	.707	.509	.993	.601	.200	.163	.472	.519	.212	.743	.990	.907
		N	183	183	173	173	183	183	183	183	183	172	183	97
20	LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials (B)	Value	-.008	.016	.089	.141	.012	.021	.095	.219**	.000	.088	-.111	.138
		Sig.	.920	.838	.272	.080	.883	.789	.226	.005	1.000	.262	.155	.178
		N	165	165	156	156	165	165	165	165	165	165	165	97
21	Local community staff time was available to conduct the HMCFS (B)	Value	.037	.034	.157*	.114	.165*	.063	.186*	-.057	.110	.108	.006	.145
		Sig.	.628	.652	.041	.138	.028	.406	.013	.452	.143	.163	.934	.158
		N	179	179	170	170	179	179	179	179	179	168	179	97
22	Budget to hire contractor to be involved in conducting the HMCFS was not available (B)	Value	.085	.081	.018	-.028	-.004	-.053	.105	.011	-.030	-.121	.047	-.003
		Sig.	.260	.281	.813	.716	.960	.484	.162	.888	.695	.117	.531	.979
		N	179	179	170	170	179	179	179	179	179	168	179	97

Table J.2 continued. Correlation matrix two for variables included in research analysis.

Variable ID and Description		1	2	3	4	5	6	7	8	9	10	11	12
23 LEPC is regional (municipal or county) jurisdiction (B)	Value	-.090	-.055	-.027	-.013	.021	.083	.100	.189[*]	.032	.069	.136	.061
	Sig.	.232	.462	.730	.867	.775	.271	.182	.011	.666	.371	.068	.552
	N	180	180	170	170	180	180	180	180	180	169	180	97
24 LEPC members or associates conducted HMCFS (B)	Value	.091	.109	.033	.103	.025	.034	.099	-.147[*]	.065	.050	-.016	-.012
	Sig.	.224	.144	.671	.177	.734	.649	.187	.048	.381	.515	.829	.910
	N	181	181	172	172	181	181	181	181	181	170	181	96
25 Absolute value of difference between percent of jurisdiction that voted R and D for U.S. President in 2008 (R)	Value	.010	.067	-.024	-.015	-.010	-.031	.069	-.101	-.042	-.039	.059	-.143
	Sig.	.891	.375	.759	.848	.895	.683	.362	.180	.574	.622	.433	.167
	N	177	177	167	167	177	177	177	177	177	166	177	95

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Variable IDs (type): 1. Communicative information selection (O); 2. Communicative information selection (B); 3. Number of selected HMCFS information sources (R); 4. Number of selected HMCFS information types (R); 5. Local planning agency/authority employees participated in HMCFS (B); 6. HazMat responders participated in HMCFS (B); 7. Diversity of HMCFS Participants (R); 8. Frequency of LEPC formal meetings (times/year) (R); 9. Square root of number of years in which LEPC has conducted HMCFS (R); 10. LEPC has ever asked another LEPC for a copy of their HMCFS (B); 11. Primary reason for CFS: Communities/regional planning agencies requested it (B); 12. Natural log of total LEPC budget in 2007 per thousand population (R)

Table J.3. Correlation matrix three for variables included in research analysis.

Variable ID and Description		1	2	3	4	5	6	7	8	9	10	11	12
26	Level of agreement that conducting HMCFS has had support of local politicians (O)	Value	.131	.136	.184*	.098	.066	.127	.098	.037	.036	.159*	-.129	.115
		Sig.	.093	.081	.020	.219	.403	.103	.209	.635	.643	.042	.099	.263
		N	165	165	158	158	165	165	165	165	165	165	165	97
27	Banking and insurance sector is major area employer (B)	Value	.021	-.022	-.040	-.102	.046	.020	.054	-.073	-.029	-.012	-.024	-.024
		Sig.	.793	.778	.616	.201	.563	.798	.489	.355	.714	.874	.760	.815
		N	164	164	157	157	164	164	164	164	164	164	164	97
28	Mining or raw materials sector is major area employer (B)	Value	.197*	.220**	.261**	.141	.030	.216**	.264**	.098	.100	.100	-.053	.042
		Sig.	.012	.005	.001	.078	.707	.005	.001	.211	.201	.202	.501	.680
		N	164	164	157	157	164	164	164	164	164	164	164	97
29	Jurisdiction is significant HazMat origin (B)	Value	.159*	.144	.191*	.111	.131	-.044	.093	.153*	-.028	-.009	.139	-.013
		Sig.	.033	.054	.013	.150	.079	.561	.213	.040	.711	.906	.062	.899
		N	180	180	170	170	180	180	180	180	180	169	180	95
30	Level of perceived hazmat transport incident risk for roads (O)	Value	.043	.006	.122	.049	-.010	.044	.122	-.065	.053	.079	-.012	.002
		Sig.	.563	.934	.110	.525	.896	.554	.099	.385	.474	.305	.869	.984
		N	182	182	172	172	182	182	182	182	182	171	182	96
31	LEPC region is Midwest U.S. (B)	Value	-.054	-.057	-.069	-.018	.005	-.186*	-.243**	-.053	.076	-.149	-.004	.176
		Sig.	.471	.445	.365	.817	.946	.012	.001	.473	.310	.052	.961	.084
		N	183	183	173	173	183	183	183	183	183	172	183	97
32	LEPC is in Texas (B)	Value	.110	.086	.074	-.012	.041	-.046	.112	-.053	-.034	-.065	.151*	-.258*
		Sig.	.137	.248	.331	.872	.577	.540	.130	.474	.645	.395	.041	.011
		N	183	183	173	173	183	183	183	183	183	172	183	97
33	Natural log of jurisdiction population (R)	Value	.038	-.007	-.026	-.061	.110	.158*	.059	.150*	-.093	.030	.004	-.163
		Sig.	.609	.925	.735	.423	.137	.032	.425	.043	.213	.696	.957	.112
		N	183	183	173	173	183	183	183	183	183	172	183	97
34	Natural log-based transformation of percent population that is White (higher value is lower percentage) (R)	Value	-.037	-.089	-.073	-.071	.103	.027	.053	.011	-.031	-.076	.119	**-.304****
		Sig.	.621	.239	.350	.360	.171	.724	.486	.885	.680	.329	.112	.003
		N	178	178	168	168	178	178	178	178	178	167	178	96
35	Informant is LEPC Chair, Director, Administrator, Coordinator, etc. (B)	Value	-.003	-.025	.186*	.164*	.004	-.081	.022	.039	.101	.041	-.098	.263**
		Sig.	.973	.738	.016	.034	.959	.284	.768	.611	.182	.599	.198	.010
		N	176	176	166	166	176	176	176	176	176	167	176	96

Table J.3 continued. Correlation matrix three for variables included in research analysis.

	Variable ID and Description		1	2	3	4	5	6	7	8	9	10	11	12
36	Informant has emergency management, emergency services, or public safety related occupation (B)	Value	-.026	.013	-.022	-.047	-.055	-.081	.000	-.143	.019	-.048	.010	.086
		Sig.	.739	.869	.778	.549	.475	.292	.995	.060	.804	.544	.895	.408
		N	173	173	163	163	173	173	173	173	173	162	173	94
37	Survey participation request was distributed by SERC (B)	Value	.032	.068	-.160*	-.076	.103	.056	-.021	.084	-.016	-.054	-.065	-.052
		Sig.	.672	.361	.035	.323	.167	.448	.777	.258	.830	.485	.385	.611
		N	183	183	173	173	183	183	183	183	183	172	183	97
38	Number of years since most-recent HMCFS was conducted (R)	Value	.005	-.005	.007	-.050	.044	-.043	-.062	-.089	**-.346****	.058	-.054	.101
		Sig.	.948	.945	.931	.516	.557	.559	.401	.233	.000	.449	.470	.324
		N	183	183	173	173	183	183	183	183	183	172	183	97

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Variable IDs (type): 1. Communicative information selection (O); 2. Communicative information selection (B); 3. Number of selected HMCFS information sources (R); 4. Number of selected HMCFS information types (R); 5. Local planning agency/authority employees participated in HMCFS (B); 6. HazMat responders participated in HMCFS (B); 7. Diversity of HMCFS Participants (R); 8. Frequency of LEPC formal meetings (times/year) (R); 9. Square root of number of years in which LEPC has conducted HMCFS (R); 10. LEPC has ever asked another LEPC for a copy of their HMCFS (B); 11. Primary reason for CFS: Communities/regional planning agencies requested it (B); 12. Natural log of total LEPC budget in 2007 per thousand population (R)

Table J.4. Correlation matrix four for variables included in research analysis.

	Variable ID and Description		13	14	15	16	17	18	19	20	21	22	23	24	25
13	Natural log of amount of non-local funding for most-recent HMCFS per thou. pop. (R)	Value	1												
		Sig.													
		N	138												
14	Other HMCFS examples were used to guide HMCFS (B)	Value	.065	1											
		Sig.	.452												
		N	135	180											
15	Contractor knowledge/experience with process was used to guide HMCFS (B)	Value	.243**	-.130	1										
		Sig.	.005	.083											
		N	135	180	180										
16	Transportation carriers participate in LEPC (B)	Value	-.027	.031	.082	1									
		Sig.	.760	.697	.304										
		N	128	161	161	164									
17	'Other' group representatives participate in LEPC (B)	Value	.007	.022	-.037	.019	1								
		Sig.	.941	.783	.646	.809									
		N	128	161	161	164	164								
18	Primary reason for CFS: The HMCFS seemed a good way to get handle on hazmat flows (B)	Value	.175*	.240**	.001	-.013	-.032	1							
		Sig.	.040	.001	.994	.871	.688								
		N	138	180	180	164	164	183							
19	Primary reason for CFS: SERC suggested LEPC conduct a CFS (B)	Value	.024	-.042	-.073	.104	.140	-.079	1						
		Sig.	.776	.574	.333	.186	.074	.285							
		N	138	180	180	164	164	183	183						
20	LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials (B)	Value	.053	.027	-.019	.168*	.227**	-.005	-.016	1					
		Sig.	.554	.730	.810	.032	.004	.953	.841						
		N	129	162	162	162	162	165	165	165					
21	Local community staff time was available to conduct the HMCFS (B)	Value	.046	.186*	-.237**	.006	-.035	.195**	-.015	-.104	1				
		Sig.	.600	.013	.001	.943	.661	.009	.842	.186					
		N	135	177	177	160	160	179	179	163	179				
22	Budget to hire contractor to be involved in conducting the HMCFS was not available (B)	Value	-.129	.007	-.269**	-.170*	.114	-.052	.027	-.093	.054	1			
		Sig.	.137	.923	.000	.032	.152	.489	.722	.235	.473				
		N	135	177	177	160	160	179	179	163	179	179			

Table J.4 continued. Correlation matrix four for variables included in research analysis.

Variable ID and Description		13	14	15	16	17	18	19	20	21	22	23	24	25
23 LEPC is regional (municipal or county) jurisdiction (B)	Value	.178*	-.026	-.019	.041	-.136	.067	-.057	.027	.040	-.168*	1		
	Sig.	.039	.735	.805	.605	.086	.368	.446	.732	.596	.026			
	N	136	177	177	161	161	180	180	162	176	176	180		
24 LEPC members or associates conducted HMCFS (B)	Value	-.019	.326**	-.443**	-.042	-.035	.176*	-.081	-.122	.379**	.179*	-.057	1	
	Sig.	.823	.000	.000	.598	.655	.018	.280	.118	.000	.017	.452		
	N	137	178	178	162	162	181	181	164	178	178	178	181	
25 Absolute value of difference between percent of juris. that voted R and D for U.S. President in 2008 (R)	Value	-.164	.046	-.129	.008	-.008	-.074	-.014	-.206**	.124	.090	-.041	.124	1
	Sig.	.059	.548	.089	.919	.917	.327	.852	.009	.105	.238	.584	.103	
	N	133	174	174	158	158	177	177	159	173	173	177	175	177

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table J.5. Correlation matrix five for variables included in research analysis.

Variable ID and Description		13	14	15	16	17	18	19	20	21	22	23	24	25
26 Level of agreement that conducting HMCFS has had support of local politicians (O)	Value	.042	.205**	.227**	.004	.115	.017	.122	.044	-.217**	-.028	-.036	.025	.177*
	Sig.	.592	.009	.003	.962	.143	.824	.120	.577	.006	.724	.645	.756	.045
	N	162	162	164	164	165	165	163	161	161	162	163	159	129
27 Banking and insurance sector is major area employer (B)	Value	.047	.050	.128	.124	-.159*	-.009	.081	.037	-.112	-.063	-.049	.053	-.145
	Sig.	.556	.531	.104	.116	.042	.910	.308	.641	.158	.425	.538	.510	.104
	N	161	161	162	162	164	164	162	161	161	161	163	158	128
28 Mining or raw materials sector is major area employer (B)	Value	.047	.026	.075	.051	.047	-.031	.179*	.095	-.081	.161*	-.165*	-.029	.030
	Sig.	.555	.747	.341	.520	.552	.689	.022	.231	.306	.041	.035	.715	.736
	N	161	161	162	162	164	164	162	161	161	161	163	158	128
29 Jurisdiction is significant HazMat origin (B)	Value	.045	.045	.237**	.072	.015	-.090	.100	-.019	-.045	.213**	-.062	-.054	.040
	Sig.	.554	.554	.002	.366	.845	.228	.203	.802	.553	.004	.413	.477	.647
	N	177	177	161	161	180	180	162	176	176	177	178	174	136
30 Level of perceived hazmat transport incident risk for roads (O)	Value	-.102	.007	-.017	.100	-.110	.067	-.074	-.103	-.093	.007	-.142	-.089	-.008
	Sig.	.172	.923	.826	.206	.138	.365	.346	.171	.217	.926	.057	.240	.922
	N	179	179	163	163	182	182	164	178	178	179	180	176	138
31 LEPC region is Midwest U.S. (B)	Value	-.030	-.193**	-.123	.084	-.008	.012	-.030	-.063	-.004	-.122	.102	-.092	-.001
	Sig.	.688	.009	.117	.286	.917	.873	.698	.402	.958	.102	.172	.223	.995
	N	180	180	164	164	183	183	165	179	179	180	181	177	138
32 LEPC is in Texas (B)	Value	.077	-.008	.052	.025	.008	-.024	-.195*	.126	.031	-.006	.081	.299**	-.114
	Sig.	.307	.916	.509	.753	.910	.746	.012	.092	.677	.931	.277	.000	.182
	N	180	180	164	164	183	183	165	179	179	180	181	177	138
33 Natural log of jurisdiction population (R)	Value	.022	.145	.252**	.079	.043	.142	.174*	-.090	-.151*	.190*	-.208**	-.263**	.023
	Sig.	.772	.053	.001	.312	.563	.056	.025	.233	.043	.011	.005	.000	.785
	N	180	180	164	164	183	183	165	179	179	180	181	177	138
34 Natural log transformation of percent population that is White (R)	Value	-.044	.137	.183*	.034	-.009	.080	.055	-.060	-.132	.064	-.229**	.061	-.139
	Sig.	.560	.070	.021	.667	.907	.288	.493	.428	.083	.399	.002	.417	.110
	N	175	175	159	159	178	178	160	174	174	178	176	177	134
35 Informant is LEPC Chair, Director, Administrator, Coordinator, etc. (B)	Value	.111	-.039	-.139	-.181*	.082	-.085	-.060	.069	.018	.109	.050	.015	.084
	Sig.	.145	.615	.081	.022	.277	.264	.449	.365	.813	.152	.515	.849	.333
	N	173	173	159	159	176	176	160	172	172	176	174	173	134

Table J.5 continued. Correlation matrix five for variables included in research analysis.

Variable ID and Description		13	14	15	16	17	18	19	20	21	22	23	24	25
36 Informant has emergency management, emergency services, or public safety related occupation (B)	Value	-.175*	.106	.102	-.124	-.154*	-.083	-.043	-.035	-.049	-.063	-.042	.047	-.047
	Sig.	.023	.170	.207	.125	.044	.277	.597	.649	.524	.409	.590	.546	.599
	N	170	170	154	154	173	173	156	170	170	173	171	170	130
37 Survey participation request was distributed by SERC (B)	Value	-.045	-.088	.098	-.145	-.012	-.072	.041	.013	.044	.071	.066	-.073	.023
	Sig.	.545	.242	.213	.065	.874	.335	.600	.859	.554	.342	.379	.332	.789
	N	180	180	164	164	183	183	165	179	179	180	181	177	138
38 Number of years since most-recent HMCFS was conducted (R)	Value	.086	-.114	.026	.117	.129	.036	-.040	.071	.002	.005	.094	-.005	-.028
	Sig.	.251	.128	.741	.137	.081	.629	.612	.345	.979	.942	.211	.950	.748
	N	180	180	164	164	183	183	165	179	179	180	181	177	138

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Variable IDs (type): 13. Natural log of amount of non-local funding for most-recent HMCFS per thousand population (R); 14. Other HMCFS examples were used to guide HMCFS (B); 15. Contractor knowledge/experience with process was used to guide HMCFS (B); 16. Transportation carriers participate in LEPC (B); 17. 'Other' group representatives participate in LEPC (B); 18. Primary reason for CFS: The HMCFS seemed a good way to get a handle on hazmat flows (B); 19. Primary reason for CFS: SERC suggested LEPC conduct a CFS (B). 20. LEPC has mechanisms or specific functions for evaluating new ideas about hazardous materials (B); 21. Local community staff time was available to conduct the HMCFS (B); 22. Budget to hire contractor to be involved in conducting the HMCFS was not available (B); 23. LEPC is regional (municipal or county) jurisdiction (B); 24. LEPC members or associates conducted HMCFS (B); 25. Absolute value of difference between percent of juris. that voted R and D for U.S. President in 2008 (R)

Table J.6. Correlation matrix six for variables included in research analysis.

Variable ID and Description		26	27	28	29	30	31	32	33	34	35	36	37	38
26	Level of agreement that conducting HMCFS has had support of local politicians (O)	Value	1												
		Sig.													
		N	165												
27	Banking and insurance sector is major area employer (B)	Value	.022	1											
		Sig.	.779												
		N	163	164											
28	Mining or raw materials sector is major area employer (B)	Value	.129	.111	1										
		Sig.	.101	.157											
		N	163	164	164										
29	Jurisdiction is significant HazMat origin (B)	Value	.081	.044	.132	1									
		Sig.	.308	.580	.094										
		N	162	161	161	180									
30	Level of perceived hazmat transport incident risk for roads (O)	Value	-.058	-.065	.107	.028	1								
		Sig.	.463	.409	.176	.705									
		N	164	163	163	179	182								
31	LEPC region is Midwest U.S. (B)	Value	-.076	.016	-.267**	-.101	-.072	1							
		Sig.	.334	.836	.001	.179	.333								
		N	165	164	164	180	182	183							
32	LEPC is in Texas (B)	Value	.030	-.041	-.099	.041	.008	-.190*	1						
		Sig.	.702	.606	.207	.581	.918	.010							
		N	165	164	164	180	182	183	183						
33	Natural log of jurisdiction population (R)	Value	-.076	.166*	.086	.268**	.117	-.231**	-.011	1					
		Sig.	.333	.034	.274	.000	.117	.002	.885						
		N	165	164	164	180	182	183	183	183					
34	Natural log transformation of percent population that is White (R)	Value	-.064	.124	-.099	.157*	.065	-.290**	.172*	.476**	1				
		Sig.	.420	.119	.216	.038	.392	.000	.022	.000					
		N	160	159	159	175	177	178	178	178	178				
35	Informant is LEPC Chair, Director, Administrator, Coordinator, etc. (B)	Value	.058	-.018	.100	.051	.064	-.010	-.152*	-.150*	.004	1			
		Sig.	.466	.818	.208	.507	.402	.893	.044	.047	.963				
		N	160	159	159	173	175	176	176	176	174	176			

Table J.6 continued. Correlation matrix six for variables included in research analysis.

Variable ID and Description		26	27	28	29	30	31	32	33	34	35	36	37	38
36 Informant has emergency management, emergency services, or public safety related occupation (B)	Value	.180[*]	.066	.084	-.090	-.009	-.011	-.008	-.194[*]	-.060	-.116	1		
	Sig.	.025	.416	.298	.242	.908	.887	.916	.010	.439	.132			
	N	155	154	154	170	172	173	173	173	171	170	173		
37 Survey participation request was distributed by SERC (B)	Value	-.093	-.019	.020	.055	-.073	.130	-.092	.048	-.020	-.029	-.050	1	
	Sig.	.237	.813	.802	.460	.329	.080	.213	.516	.796	.707	.512		
	N	165	164	164	180	182	183	183	183	178	176	173	183	
38 Number of years since most-recent HMCFS was conducted (R)	Value	-.197[*]	.113	.006	.000	-.056	-.016	.037	.064	-.129	.000	-.091	-.088	1
	Sig.	.011	.148	.941	.995	.454	.829	.614	.386	.086	.999	.236	.235	
	N	165	164	164	180	182	183	183	183	178	176	173	183	183

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

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- <u>Principal Investigator</u>: *Hazardous Materials Commodity Flow Studies for Local Emergency Planning.* Texas Division of Emergency Management.
  - October 2011-September 2012
  - February 2011-September 2011
  - January 2010-September 2010
  - January 2009-October 2009
- <u>Principal Investigator</u>: *Collection and Analysis of HazMat Shipment Information in the El Paso Region.* Center for Intelligent International Transportation Research, Texas Transportation Institute. September 2011-August 2012.
- <u>Co-Principal Investigator</u>: *Hazardous Materials Commodity Flow Data and Analysis*. The National Academies, Transportation Research Board, Hazardous Materials Cooperative Research Program. March 2007-May 2010.

Selected Teaching Experience:

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Selected Publications:

D.H. Bierling, G.O. Rogers, D.L. Jasek, A.A. Protopapas, J.E. Warner, L.E. Olson. *Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies.* HMCRP Report 3. The National Academies, Transportation Research Board. August 2011.