

Predicting Disaster Response Effectiveness*

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What social factors best predict the relative effectiveness of community disaster responses? This question is explored through interview and questionnaire data obtained from 62 local emergency managers whose communities were impacted by some type of disaster event. Various coordination strategies used in the year prior to the event and during the response were assessed first. These and numerous other potential sources of constraint were used in regression analyses to determine predictors of response effectiveness (both as perceived by the local emergency manager and through ten evaluative criteria). Results indicated that both measures of response effectiveness were predicted by seven factors: 1) high level of domain consensus; 2) use of more coordination strategies by the local emergency manager during the response; 3) more lengthy period of forewarning; 4) more frequent disaster training activities and actual responses during the prior two years; 5) more frequent participation by local emergency manager in local service organizations; 6) high community growth rate; and 7) use of more managerial strategies by the local emergency manager during the prior year.

Disasters strike communities throughout the U.S.A. with awesome regularity (for frequency data see Mileti 1999, pp. 65-104; Drabek 2004, pp. 4-5—4-21). For example, ever 20 years hurricane property losses range between \$11 and \$111 billion with peaks like 1992 when Andrew and Iniki totaled between \$1.6

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billion and \$16 billion (Mileti 1999, p. 77). While less costly in property losses (20 year estimate at \$5.8 to \$58 billion; Mileti 1999, p. 82), tornadoes are much more deadly (1,090 killed between 1975 to 1994, Mileti 1999, p. 82, versus 173 hurricane deaths during the same time period, p. 76). They also injure far more victims (23,507 people were injured between 1975 to 1994 by tornadoes, whereas hurricane related injuries peaked in 1983 when Alicia impacted Texas and injured 1,800 but no such injuries were reported in 1978, 1981, 1987, 1990 and 1994; see Mileti 1999, p. 82 and pp. 76-77).

Reflecting national investments in an array of technologies, improved weather forecast models, and preparedness activities of various types, the emergency social systems within many communities frequently are mobilized long before impact (Barton 1969; Dynes 1970; Drabek 1986). For example, as hurricanes move across the Atlantic, they are monitored for days thereby providing local governments opportunity to warn and evacuate threatened populations, both residential (e.g., Sorensen et al. 1987; Sorensen and Mileti 1988; Peacock et al. 1997) and transient (Drabek 1994, 1996). Other times, however, disaster strikes with minimal or no warning. Flash floods (e.g., Gruntfest 1977), tornadoes (e.g., McEntire 2001; Moore 1958) and earthquakes (e.g., Goltz et al. 1992; Anderson 1970) are among the hazards that rarely permit mobilization prior to impact.

Although there were a few social science oriented studies prior to 1950 (e.g., Prince 1920), modern day disaster research had its origins in a series of field investigations conducted by research teams associated with the University of Chicago (e.g., Fritz and Marx 1954), Maryland (e.g., Powell 1954) and Oklahoma (e.g., Logan et al. 1952) (for historical summary of these works see Quarantelli 1987). Building on the legacy of these efforts, subsequent years has produced hundreds of analyses of community responses and various sub-systems ranging from individuals, groups, and organizations (e.g., Drabek 1986, 2004; Kreps 2001). These empirical studies have debunked numerous myths about human behavior during disaster responses (e.g., Quarantelli 1960; Quarantelli and Dynes 1977, 1972; Fischer 1998; Drabek 2004) and have impacted national and organizational policies regarding disaster response and mitigation (e.g., NSF 1980; Dynes and Drabek 1994). Despite the breadth of the issues studied, however, few have broached the matter of response effectiveness. Although some have proposed helpful analyses of this very complex topic (e.g., Quarantelli 1997, Gillespie and Streeter 1987), no one has published empirically based results derived from a comparative design through which the social factors that might constrain the degree of response effectiveness could be assessed. Findings and conclusions flowing from the study reported herein *are no more than a first step* toward this important but illusive topic, but they do point toward a significant research agenda of both theoretical and practical consequence.

Theory and Method

Data were collected and interpreted within the stress-strain theoretical perspective e.g., Haas and Drabek 1973; Drabek and Haas 1974, 1969; Drabek 2000, 1999, 1994, 1990. This perspective complements and augments “emergent norm theory” (e.g., Turner 1964, Perry 1983) and the “bounded rationality” model formulated by Simon (1956, 1957) that has been applied so effectively by Burton et al. (1993). Like executives in other types of organizations, local emergency managers were viewed as making choices within the context of highly uncertain and incomplete information bases. Thus, during both disaster responses and non-disaster times, they engage in bargaining actions reflecting their perceptions of community needs and desired courses of action. Through a variety of managerial strategies they seek to nurture inter-agency structures that represent key resource nodes that can be mobilized when disaster is imminent. And as major threats approach, those most effective in their jobs, will use a series of coordination strategies with which to facilitate the emergence of a multiorganizational network through which appropriate resources can be directed toward the demands generated by a disaster event.

Managerial choices and actions (Drabek 1987), like those of tourists confronting the uncertainties of evacuation advisories (e.g., Drabek 1996), can be interpreted and somewhat predicted by unraveling multiple layers of social constraint. These layers reflect various characteristics of the emergency manager, (e.g., age and education), the local agency (e.g., number of personnel and frequency of participation in disaster training) and community characteristics (e.g., size and growth pattern). And when disaster strikes, certain event characteristics define and limit the range of choices perceived to be available (e.g., length of forewarning and scope of impact). The stress/strain perspective suggests that these multiple areas of constraint can thus be used to explain the variation in disaster responses among local emergency managers and the corresponding degrees of effectiveness reflected in such.

This broad perspective guided the formulation of four research questions that comprise the focus of the analysis summarized in this article: 1) What social factors predict the use of managerial strategies designed to maintain the integrity of local emergency management agencies prior to a disaster event?; 2) What social factors predict which local emergency managers will use the greatest number of coordination strategies during a specific disaster response?; 3) What social factors will predict community responses that are perceived by local emergency managers as being the most effective?; and 4) What social factors predict actual disaster response effectiveness?

The study design was comprised of two phases. First, field studies were conducted in ten communities. During May, 1999, five experienced disasters with minimal forewarning (flash flooding—Otero and Pueblo Counties, Colorado; tornadoes—the City of Moore and Oklahoma County, Oklahoma and Sedgwick County, Kansas). Two hurricanes with lengthy forewarning periods provided a counterpoint, i.e., Hurricane Bret—City of Corpus Christi and Kleberg County, Texas; Hurricane Floyd—New Hanover and Pitt County, North Carolina and Horry County, South Carolina. During each of the field visits, the local emergency manager was interviewed in two or three sessions that totaled four to six hours. Although they are not relevant to the analyses herein reported, additional cross-referencing interviews ($n = 89$) were conducted with executives from a variety of other local agencies, e.g., police, fire, public works, elected official, Red Cross, etc. Reflecting the stress-strain perspective, the interview guide was comprised of items pertaining to the structure of the emergent multiorganizational networks (EMONS), e.g., frequency of agency contact, and the strategies used to facilitate coordination. Following each interview a brief mail back questionnaire was provided (100% return rate). Liaison assistance was provided by a project advisory committee comprised of 10 nationally recognized individuals with backgrounds in emergency management or disaster research (see Drabek 2003b, p. x and pp. 6-7). Their assistance plus the name recognition of the author within the local emergency management community contributed to the high levels of cooperation and quality of data collected in both phases of the study design.

Field study data helped identify and clarify a range of coordination strategies that were implemented to varying degrees by the 10 local emergency managers following their date with disaster. This information was used to formulate a more focused interview schedule that could guide a limited data collection effort but one that could include a larger number of emergency managers. Thus, Phase II was a telephone survey with a nationally based sample of 52 local emergency managers. A news clipping file (August, 1999—February, 2000) was used to identify community disasters. The sample obtained reflected variation in type of disaster agent and community population size. Disaster agents included: floods (21%); tornadoes (27%); hurricanes (26%); earthquakes (5%); wildfires (13%) and other events (8%—includes large scale structural collapses and hazardous materials incidents). Community populations were: 49,000 or less—36%; 50,000-199,999—37%; 200,000-399,999—10%; 400,000 or more—18%. Interviews averaged one hour and were followed with the mailing of the same questionnaire used in Phase I. The return rate of 100 percent was gratifying (for additional details, see Drabek 2003b, pp. 34-40).

Listings of the 62 communities, profiles of the local emergency managers (e.g., age and gender) and their agencies (e.g., number of employees, and size

of budget), and specification of the disaster events studied has been detailed elsewhere (Drabek 2003b, pp. 19-40). Thus, distributional information on these characteristics may be obtained if desired. There are four variables, however, that comprise the focus of this analysis, i.e., managerial strategies, coordination strategies, perceived network effectiveness, and actual effectiveness. Conceptualization and measurement of these four were as follows.

Managerial Strategies. Based on prior studies using conceptual frameworks developed by Thompson (1967), Pfeffer (1981), Child (1972), and especially Pennings (1981), Drabek (1990, 1987) identified 15 managerial strategies used by the most effective local emergency managers to maintain the integrity of their agencies and to promote interagency cooperation. Eleven of these were included in the questionnaire. In accordance with recommendations from the project advisory committee regarding questionnaire length and item content, it was decided that these 11 would provide an adequate assessment rather than using all 15. Hence, items pertaining to four managerial strategies documented previously (Drabek 1990) were deleted from the initial draft of the questionnaire (i.e., mergers, regulation, product differentiation, and flow of personnel).

Four response categories were used: 1) frequently; 2) a few times; 3) occasionally; 4) no opportunity to do so. Each item was preceded by the statement: "During the *past year* I have:" Use of the constituency strategy reflected this item: "helped other agencies improve their *resource base*." Use of joint venture and cooptation strategies were assessed by these two items: "participated in *joint ventures* with other agencies"; "met with an *advisory committee* I formed for my agency." An index for the "use of managerial strategies" was created by summing the score (1-4) assigned to the eleven items and dividing the total by number of items for which there was a response, typically 11. While the potential index range was 1-4, the final score range was 1.0-3.4 with an average of 2.2. See Table 1 for a list of the 11 items and their frequency of reported use. This index had a reasonable degree of internal consistency (Cronbach's Alpha = .704; split-half = .774).

Coordination Strategies. Reflecting a five-fold typology of strategic choice developed by Osborne and Plastrik (1998), the ten local emergency managers in the Phase I field studies were asked if they used and/or could illustrate their use of five types of strategies during the disaster response: 1) core; 2) consequence; 3) customer; 4) control; and 5) cultural. Extensive probes followed their initial responses. Data analysis revealed documentation of 26 specific strategies that were implemented to varying degrees by the 62 emergency managers as they tried to facilitate interagency coordination during the disaster response. These 26 strategies reflected all aspects of the five-fold typology of strategic choice, i.e., Osborne and Plastrik (1998).

Table 1: Use of Managerial Strategies*

Managerial Strategies	Frequency of Use**			
	Frequently	Few Times	Occasionally	None
Resource Base	32 (20)	26 (16)	39 (24)	3 (2)
Committees	51 (31)	16 (10)	25 (15)	8 (5)
Advisory Committee	21 (12)	14 (8)	28 (16)	38 (22)
Joint Ventures	57 (35)	21 (13)	16 (10)	7 (4)
Agenda Control	23 (14)	26 (16)	28 (17)	23 (14)
Non-local Resources	34 (21)	26 (16)	29 (18)	11 (7)
Media Relations	33 (20)	16 (10)	46 (28)	5 (3)
Outside Expert	8 (5)	23 (14)	39 (24)	31 (19)
New Programs	37 (23)	18 (11)	36 (22)	10 (6)
Liaison Personnel	44 (27)	26 (16)	24 (15)	7 (4)
Mutual Aid Agreements	56 (34)	16 (10)	20 (12)	8 (5)

*Questionnaire items were preceded with this introductory phrase: "During the past year I have:" Then the following items appeared as a list with the four response categories specified above ("none" was listed as "no opportunity to do so"). 1. "helped other agencies improve their *resource base*"; 2. "used *committees* to improve the disaster response capability of this community"; 3. "met with an *advisory committee* I formed for my agency"; 4. "participated in *joint ventures* with other agencies"; 5. anticipated *potential controversies* relevant to my agency and took actions that nipped them in the bud before they got out of hand"; 6. "been successful in *securing resources* from non-local sources, e.g., federal or foundation grants"; 7. "effectively involved *local media personnel* in disaster planning"; 8. "arranged for an *outside expert* to visit our community to help other agencies better understand our vulnerabilities or some other issue"; 9. "implemented *new programs* or other innovations like computer technologies within my agency"; 10. "arranged for *liaison personnel* from other agencies to serve as key contacts for me and my staff"; 11. "created and/or maintained *mutual aid agreements* with various community organizations and agencies".

**The number in parenthesis is the actual number of emergency managers who selected the response listed; percentage based on exact number of emergency managers who responded to the questionnaire item listed.

During the Phase II telephone survey, each local manager was asked whether or not they used each of these 26 strategies, e.g., core—domain clarifications; consequence—display of decisions; customer—facilitation of media relations; control—emergent collaborative planning; and cultural—enhance awareness of cultural difference among responding agencies. Use of each coordination strategy during any one of these disaster phases (i.e., evacuation, emergency response, and restoration) was scored as: 1) yes; 2) passive; or 3) no. The "passive" code reflected instances wherein local emergency managers reported implementation of the strategy by another agency executive, not themselves.

Table 2 is a listing of the 26 coordination strategies for three disaster phases. For description and illustration of all 26 coordination strategies, see Drabek 2003a and Drabek 2003b, pp. 67-121. The following examples, one for each of the five core types, provide a sense of the complexity and subtlety that an

**Table 2: Use of 26 Coordination Strategies by
62 Local Emergency Managers**

Coordination Strategy	% Use During Disaster Phases (n = 62)								
	Evacuation			Emergency Response			Restoration		
	Yes	Passive	No	Yes	Passive	No	Yes	Passive	No
Core									
Domain Clarifications	52	2	47	50	3	47	54	2	44
Jurisdictional Negotiations	31	3	66	34	5	61	39	2	59
Resource Familiarizations	95	2	3	97	2	2	97	2	2
Consequence									
Display of Decisions	90	8	2	92	7	2	93	5	2
Use of Information									
Technologies	82	5	13	82	5	13	82	3	25
Maintenance of Hospitable									
EOC Social Climate	84	5	12	85	5	10	82	7	12
Customer Communication of Citizen Expectations & Requests	94	3	3	97	3	0	93	3	3
Facilitation of Media									
Relations	81	15	5	81	28	2	79	18	3
Documentation of									
Damage Assessments	45	13	42	69	16	15	84	15	2
Documentation of Disaster Repairs and Restorations	5	0	95	13	3	84	79	18	3
Control Appeals to									
Prior Legitimacy	89	0	11	90	0	10	87	0	13
Reference to Planning									
Documents	94	3	3	94	3	97	3	3	0
Reference to Prior Experiences	87	3	10	87	3	10	85	2	13
Decentralization of Decision-Making	89	8	3	87	11	2	82	16	2
Use of Self-Managed Work Teams	86	13	2	86	15	0	85	15	0
Emergent Collaborative Planning	44	2	55	48	7	45	56	8	36
Emergent Community-Government Partnerships	40	2	58	47	3	50	53	3	44
Implementation of Mutual- Aid Agreements	61	3	38	66	3	31	56	0	44
Control									
Enhance Awareness of Cultural Differences among Responding Agencies	29	3	68	24	7	69	26	2	72
Enhance Awareness of Vulnerable Populations	97	0	3	97	2	2	95	2	3
Enhance Awareness of									
Community Diversity	65	2	34	68	0	32	71	2	28
Interagency Cross-Talking	88	11	2	87	11	2	87	10	3
Building Shared Vision	74	8	18	76	8	16	89	8	3
In-House School House	2	0	98	2	0	98	79	9	13
Celebrating Success	0	0	100	0	0	100	54	16	30
Monitor Stress Symptoms	74	8	18	76	7	18	72	5	23

emergency manager confronts. These illustrations are based on extensive notes taken during the interviews. While not actual quotations based on audio recordings, each quotation was written after the interview was completed.

Core strategy: Domain clarifications.

“Well, we had to get political. See we had an isolated diabetic who required insulin. I requested that a National Guard helicopter be used; due to the very bad weather we could not go commercial. There simply was no other way to get to this victim. Our state office of emergency management said that our request was turned down by the Guard and there wasn’t anything they could do. They said it was our responsibility, that we’d just have to deal with it. So we talked to one of our political people and in that conversation we came up with the idea that maybe this could be viewed as a training mission. Next thing we knew the copter was in the air to pick up the supply for delivery.”

Consequence strategy: Display of decisions.

“We found our GIS (geographic information system) was invaluable. Immediately we had a computer generated map of the tornado path. In fact, our local newspaper used our map in their coverage. We later made layers of various other types of information on this map for use by the EOC agency reps.”

Customer strategy: Communication of citizen expectations and requests.

“We had people calling asking about guidance for dealing with their kids. So we had a mental health counselor make a presentation which was well attended. This person arrived armed with some very helpful pamphlets, you know, tips on dealing with your child’s fears. We also had to go beyond English. So we had our building department do a presentation which we taped. Then we had translators go over it and we got sound tracks in different languages. This became what we called our ‘Chimney Forum.’ We followed this with additional presentations that were shown to the general public and used for staff training in several other city departments. We did one on the SBA loan processes (small business administration), FEMA applications, and mental health.”

Control strategy: Emergent collaborative planning.

“We had a lot of this because of the scope and duration of this fire. For example, I recall that when we finally were reopening the town, we were advised of a major problem at our hospital. It had been evacuated, of course, but incurred heavy smoke damage. Somehow we had to get it cleaned quickly, but a major wash down of this magnitude had never been envisioned by any of us in all of our exercises. So we got a task group to focus on this and they quickly devised a plan whereby our public works department would rent a huge sprayer. This machine was manned by National Guard personnel who really got the job done in a hurry.”

Cultural strategy: Enhance awareness of culture differences among responding agencies.

“Yes. You see each department has a personality. Our public works people work well with personnel from our utilities. So we keep them together although they rotate the chair every few hours. They can resolve their differences despite the competition among them because they talk the same language, but its more than just technical terminology. In contrast, you have your PIO cluster. You really have to let them know who is in charge. They really differ from the fire culture. They’re used to being heroes and are eager to be helpful. That contrasts to the police who seem to react as if its them against the world. Consequently, police personnel don’t want to look indecisive or admit that they don’t know. So they don’t seek our help. In contrast, fire guys are quick to tell us what they need and we can get on it. But the police, they simply will not admit that they need resources. They had officers trapped under debris but they were reluctant to let anyone in the EOC know about this. They just don’t seem to have the capacity to see the big picture and be able to open up for discussion of problems. They seem locked into an ‘either/or’ type of thinking. When you work with people from all of these different cultures in a high stress environment where there is a lot of uncertainty in the information coming in and things are changing rapidly, you really see this. Maybe the stress magnified these differences.”

Scores were summed across the 26 coordination strategies so that the maximum potential range was 26-78, i.e., “yes” responses were coded as “1”, hence a score of “26” indicated use of all of the strategies. The actual range was 29.3-69.3 with a mean score of 40.7. The index was internally consistent (Cronbach’s Alpha = .857; split-half = .820). Future research should be

designed to obtain a much better measure of this variable for comparative research. There is the possibility that the five broad types identified by Osborne and Plastrik (1998) reflect multidimensional properties. Pursuit of such a matter, however, was beyond the scope of the project herein reported.

Perceived Network Effectiveness. Near the end of the interview, each local emergency manager was asked to rate the effectiveness of the disaster response on a scale of one to five. The interview item was read as follows: "Overall, how would you rate the *effectiveness* of this *network of agencies* that responded to this disaster? Let's say on a scale of 'one' to 'five', where would you rate this response?" Of course, some managers tried to dodge the question. The most frequent ploy was to single out one aspect of the event or a specific innovation that was implemented and describe how pleased they were. When they finished, the question was rephrased slightly and asked again. Although some required a bit of a push, 62 responses were obtained that reflected their *perception* of response effectiveness.

The pattern of scores was as follows, with a "5" representing the highest degree of effectiveness: 1 = 7%; 2 = 3%; 3 = 19%; 4 = 27%; and 5 = 44%. The average score among these 62 emergency managers was 4.05.

Actual Effectiveness. E.L. Quarantelli has given such matters more thought than any other scholar, except perhaps his long time collaborator Russell R. Dynes who undoubtedly reviewed a draft of the manuscript published in 1997. Rather than focusing on outcome measures which present real problems for comparative disaster research across communities of differing sizes, hazard histories, and prime risks, Quarantelli proposed ten "process" criteria. These were: 1) agent vs. response demands; 2) generic functions accomplished; 3) personnel and resource mobilization; 4) division of labor; 5) processing information; 6) decision-making; 7) coordination; 8) blending emergent aspects; 9) information to media; and 10) functioning emergency operations center. Presumably, by assessing disaster responses on each of these criteria, the relative degree of effectiveness could be measured.

Immediately following each interview, and based on the information given throughout, all of the ten criteria proposed by Quarantelli were coded on a scale of "1" to "5", with "5" representing the highest level of performance. These ten scores were then summed to create an index with a potential range of "5" to "50". While the decision to use a scale of one to five for each criterion was arbitrary, it did provide a systematic basis for cross-community comparison and aggregation among the 10 criteria proposed by Quarantelli (1997). Future research should be completed on the use of these criteria and alternative methods of aggregation wherein the values assigned may differ among the 10 criteria. All may not be equally important. Also, as noted above regarding the coordination strategies, there is the possibility that the variable may be

multidimensional. Exploration of this and other measurement alternatives merit future research efforts. As with the other indices discussed above, the decision to sum the values assigned to multiple items to create a single score is a clear limitation of the analysis that follows. Despite the crudeness and potential difficulties inherent in such a process, however, all interviews were conducted by the author which insured that there was consistency across the process. Furthermore, the values obtained were consistent with the qualitative interpretation of each interview within the context of the total data set.

A running list of the “actual effectiveness” scores was maintained and referred to as subsequent interviews were completed to insure consistency during the several week data collection process. The actual score range turned out to be 20-50 with an average score of 42.7. Statistical tests of reliability indicated that this ten item index was internally consistent (Cronbach’s Alpha = .963; split-half = .920). As would be expected, of course, this index was correlated with, but conceptually is not the same as the measure of “perceived effectiveness” which only reflected the perceptual judgments of each local emergency manager ($r = .932$).

As will be described in the Findings section, a series of additional variables were measured. These reflected the broad areas of constraint that flowed from the stress-strain theoretical perspective which guided the data collection and interpretation. Thus, various characteristics were assessed that reflected four broad areas of constraint: 1. event characteristics (e.g., length of forewarning), 2. managerial characteristics (e.g., years of formal education), 3. agency characteristics (e.g., size of budget); and 4. community characteristics (e.g., population size). Various event characteristics were assessed by the author using the full range of 62 disasters as context, e.g., magnitude of impact was coded using a four-fold category set, i.e., 1 = minimal; 2 = moderate; 3 = disastrous; and 4 = catastrophic. U.S. Census data were used to code community population size into one of four categories: 1 = 49,999 or less; 2 = 50,000 to 299,999; 3 = 200,000 to 399,000 and 4 = 400,000 or more. Most of the other data were collected through a short mail back questionnaire that was comprised of items with fixed choice response categories. For example, “How many years of formal education have you completed?” Response categories were: 1 = 11 or less; 2 = 12; 3 = 13-15; 4 = 16; and 5 = 17 or more. Questionnaires were given to the Phase I local emergency managers ($n = 10$) at the time of their face-to-face field interview. They were mailed to the Phase II managers ($n = 52$) immediately following their telephone interview. A few follow-up telephone reminder calls were required, but eventually *all* of the 62 emergency managers returned a completed questionnaire (return rate = 100%). As noted above, distributional listings for these and other variables included in the larger study on which this analysis is based may be reviewed in Drabek 2003b.

Findings

As indicated above, four questions were addressed to improve our understanding of the types of social factors that constrain disaster response effectiveness. Thus, the following analyses provide the first empirical, cross-event assessments of factors that predict the: 1) use of certain managerial strategies to nurture interagency relationships prior to an event; 2) the use of selected coordination strategies during the response to an actual disaster event, 3) perceived disaster response effectiveness; and 4) actual disaster response effectiveness.

Managerial Strategies. What social factors best predict the use of managerial strategies designed to maintain the integrity of local emergency management agencies *prior to* a disaster event? Social factors reflecting four broad areas of constraint were examined. The sequential steps in the analysis were these. First, eight characteristics of the 62 local emergency managers were reviewed and one-way analysis of variance and bivariate correlation coefficients were computed. See the first listing at the top of Table 3.

Table 3: Social Factors That Constrained the Use of Managerial Strategies

Area of Constraint	F	r	Beta****
Managerial Characteristics			
Length of Job Tenure	.53	-.021	
Years of Formal Education	4.76**	-.300*	
Age	.62	-.157	
Length of Time in Community	.60	.174	
Participation in Local Service Organizations	3.50	.175	
Service in Active Military	.10	.094	
Service in National Guard or A/N Reserve	1.09	.142	
IAEM Member***	3.53*	-.269*	
Agency Characteristics			
Agency Size	3.51*	-.397**	-.331**
Number of Volunteers	.72	-.223	
Annual Budget	5.41**	-.292	
Participation in Disaster Training***	4.26*	.371**	.214
Frequency of Past Agency Contact***	1.85	.354**	.214
Domain Consensus***	.95	.189	
Community Characteristics			
No. of Prior Disasters (5 yrs.)	2.16	-.230	
Community Size	11.60**	-.418**	-.264*
Community Growth***	.69	-.134	

*p < .05

**p < .01

****"IAEM member" designated those executives listed in the Year 2000 Membership Directory of the International Association of Emergency Managers, the leading professional

association. "Agency Size" was based on number of full time paid employees, ranged from 1 = 3 or less to 5 = 100 or more. "Participation in Disaster Training" was based on average score for responses given by manager for each of seven core community agencies such as law enforcement, fire, public works, etc. Interview item was "Which responses best identify the number of times your agency has participated in formal disaster training exercises during the past two years? (Include joint responses to actual disasters)." Response codes varied from "1" representing "six or more formal exercises" to "4" indicating "no formal exercises". "Frequency of Past Agency Contact" was based on average score for response given by manager for each of seven core community agencies. Response categories varied from "1" representing "several times each week" to a "6" indicating "no contact". Reliability statistics were: Cronbach's Alpha = .628; split-half = .441. "Domain Consensus" was based on average score for responses given by manager for each of seven core community agencies. Interview item was: "Which response best identifies the extent to which you and the head of each of these agencies agree on the goals and priorities you should have for your agency?" Response codes varied from "1" representing "agree very much" to a "5" indicating "disagree" and "6" indicating "don't know how they view this program." "Community Size" was the population listed in the 1990 U.S. Census recoded into four categories noted in text. "Community Growth" was based on the calculation of population change between 1980 and 1990 census. Actual numbers were converted into percentages and then coded into one of six categories ranging from: 1 = decline; 2 = increase of 4.9% or less; 6 = increase of 20% or more.

****Beta weight of variable in final prediction model

Results indicated that two of these six factors were correlated significantly with the 11-item index that measured "use of managerial strategies", i.e., number of years of formal education and actual membership in the International Association of Emergency Managers (IAEM). Second, two other broad areas of constraint were reviewed, i.e., agency and community characteristics. As indicated in Table 3, three agency characteristics (agency size as measured by the number of paid employees, frequency of disaster training exercises during prior two years and frequency of past agency contact) and one community characteristic (population size) were significantly correlated to the frequency that these local disaster coordinators used the eleven managerial strategies during the year prior to the event selected for study.

The minus signs on the correlation coefficients indicated the directionality of the codings used. For example, a low score on the managerial strategies index indicated frequent use. A "5" on number of years of schooling represented the category of "17 years or more". Thus, the emergency management executives *who used the eleven managerial strategies most frequently* had completed more years of formal schooling and worked in the largest agencies as reflected in the number of paid employees and the size of their budget. They also reported more frequent disaster training exercises and agency contacts. And they resided in larger communities.

The third step was to evaluate a series of multivariate regression equations so as to identify which combination of variables would best predict the variation in the extent to which the managerial strategies were used. After numerous combinations were reviewed, it became clear that the best predictive model was comprised of the following four variables: 1) agency size (as

indicated by the number of full time employees); 2) community size; 3) frequency of participation in disaster training exercises; and 4) frequency of past agency contact. This model accounted for over one-third of the variation in the degree to which the 11 managerial strategies had been used in the year prior to the disaster selected for study (Adjusted R² = .388; F = 8.44; p < .001). Adding or deleting other variables reduced the amount of variance explained. Hence, within this data base of 62 events and local emergency managers, these four social factors were the most constraining.

Coordination Strategies. What social factors best predict which local emergency managers will use the greatest number of the 26 coordination strategies during a specific disaster response? Analyses were conducted that paralleled the steps just described. This time, however, several characteristics of the disaster event were included as a separate broad area of constraint. These were not included in the analysis of the use of the managerial strategies during the year prior to the event selected for study since it had not yet occurred (i.e., Table 3). Thus, as listed in Table 4, six disaster characteristics were added to the mix of social factors that were explored. And, as might be expected, several of these appeared to constrain the actions of these executives, including the number of coordination strategies that they implemented throughout the life cycle of the event that impacted their community (see Table 2 for a list of the 26 coordination strategies and related text for index construction procedures). Clearly, the emergency managers that reported use of more of the 26 coordination strategies confronted events of greater magnitude that were more extensive in scope and duration of impact.

But the data in Table 4, also indicated additional sources of constraint. For example, the use of the 26 coordination strategies also was correlated with schooling. That is, the greater number of years of formal education completed by the emergency manager, the more frequent the use of the coordination strategies. So too was the length of time they had been living in their community (shorter) and the frequency they had used the 11 managerial strategies to nurture interagency relationships during the year prior to the event selected for study. As an indicator of professionalism, active membership in the International Association of Emergency Managers (IAEM) also was positively correlated. Two agency characteristics proved to be important social factors as well: 1) frequency of participation in disasters, namely the frequency of their participation in disaster training exercises with seven core community response units like law enforcement and fire, and 2) the degree of domain consensus, i.e., agreement on agency goals and objectives. Finally, both overall population size and growth were correlated with the use of the 26 coordination strategies. Of course there were many interdependencies or intercorrelations among these social factors.

**Table 4: Social Factors That
Constrained Use of Coordination Strategies**

Area of Constraint	F	r	Beta****
Event Characteristics			
Length of Forewarning	1.64	-.178	
Uncertainty of Forewarning	2.39	.200	
Magnitude of Impact	3.40**	-.327**	
Uncertainty of Impact	2.36	-.247*	
Scope of Impact	4.61**	-.384**	-.178
Duration of Impact	4.28**	-.452**	
Managerial Characteristics			
Length of Job Tenure	.68	.031	
Years of Formal Education	2.75*	-.320**	-.175
Age	1.42	.016	
Length of Time in Community	3.26*	.377**	.112
Participation in Local Service			
Organizations	.96	.094	
Service in Active Military	.55	.101	
Service in National Guard or A/N Reserve	1.66	.187	
IAEM Member	2.44	.323**	.199
Use of Managerial Strategies	2.01	.382**	.188
Agency Characteristics			
Agency Size	.87	-.035	
Number of Volunteers	.73	-.196	
Annual Budget	.37	-.137	
Participation in Disaster Training	3.79**	.477**	.262
Frequency of Past Agency Contact	1.11	.197	
Domain Consensus	4.40**	.365**	
Community Characteristics			
No. of Prior Disasters	2.03	-.222	
Community Size	2.65*	-.301*	.181
Community Growth	5.16**	-.424**	-.21

*p < .05

**p < .01

*** “Length of Forewarning” was coded as “1” representing a short forewarning, e.g., flash flood, tornado, earthquake or a “2” indicating a long forewarning, e.g., hurricane or riverine flooding. “Uncertainty of Forewarning” ranged from “1” = Low to “2” = Medium to “3” = High. These same codes were used for “Uncertainty of Impact.” “Magnitude of Impact”: 1 = Minimal; 2 = Moderate; 3 = Disastrous; 4 = Catastrophic. “Duration of Impact”: 1 = Brief; 2 = Moderate; 3 = Lengthy.

****Beta weight of variable in final prediction model

After several alternatives were explored, it became clear that a seven variable model best predicted the use of the 26 coordination strategies. This model accounted for over 40 percent of the overall variation (Adjusted $R^2 = .404$; $F = 4.90$; $p < .001$). The right hand column of Table 4 identifies these variables and their respective Beta weights. Given the directionality of the coding schema, the model documented that among these 62 local emergency managers, those who implemented the greatest number of the 26 coordination strategies during the life cycle of the disaster response had *more frequently participated in disaster training exercises* and actual responses during the two years prior. They also worked in *larger communities* that had experienced the *highest levels of population growth*. They were more apt to be current *members of the IAEM*, had completed *more years of formal schooling*, but had *resided in the community for shorter periods* of time. Reflecting their professionalism, a quality previous research (e.g., Drabek 1987) had documented as being most relevant, those who implemented more of the coordination strategies during the disaster response also had used *more of the 11 managerial strategies* in the year prior to enhance agency integrity and nurture interagency relationships. Finally, the events they were challenged to manage were more *extensive in scope of impact*. Thus, this composite mix of diverse areas of social constraint provided the first empirical documentation of who would most likely implement such coordination strategies and under what circumstances.

Perceived Response Effectiveness. As described above, not all of the interviewees perceived the community response in glowing terms. Some were quite forthright in identifying areas of difficulty and failure. When asked to rate the overall effectiveness of the multiagency network response, some had to be pushed a bit to provide quantification. While problematics often were discussed, many expressed the view that assigning a single rating seemed not to tell the whole story of their efforts. And, of course, they were right! Such matters are infinitely more complex. Some aspects of a response may go well, like warning or evacuation phases, while others may reflect more conflict or surprises. After some prodding, however, all selected a number between one and five which was recorded as their “perceived response effectiveness” score. What social factors would best predict this range of scores? The answers are reviewed in Table 5.

The same type of analyses were conducted as described above. These documented several areas of constraint including one event characteristic (length of forewarning), three managerial characteristics (participation in local service organizations and greater use of both the managerial and coordination strategies), three agency characteristics (participation in past disaster training, greater frequency of past agency contact, and higher levels of agreement on agency goals and objectives with other agency directors, i.e., domain consensus). Finally, a higher level of community growth also was positively correlated with perceived effectiveness.

Table 5: Factors That Constrained Perceived Response Effectiveness

Area of Constraint	F	r	Beta****
Event Characteristics			
Length of Forewarning	3.33*	.377**	-.018
Uncertainty of Forewarning	.92	.093	
Magnitude of Impact	2.56*	-.157	
Uncertainty of Impact	2.12	.053	
Scope of Impact	.89	-.119	
Duration of Impact	1.10	.114	
Managerial Characteristics			
Length of Job Tenure	.41	-.081	
Years of Formal Education	.61	-.090	
Age	.80	-.174	
Length of Time in Community	1.21	-.189	
Participation in Local Service			
Organizations	2.15	-.321**	
Service in Active Military	1.01	-.216	
Service in National Guard or A/N Reserve	.91	-.144	
IAEM Member	2.13	-.039	
Use of Managerial Strategies	1.19	-.285*	
Use of Coordination Strategies	9.79**	-.453**	1.009**
Agency Characteristics			
Agency Size	.16	.072	
Number of Volunteers	1.31	.145	
Annual Budget	.37	-.002	
Participation in Disaster Training	9.20**	-.608**	-.050
Frequency of Past Agency Contact	1.89	-.332**	-.040
Domain Consensus	9.71**	-.617**	.003
Community Characteristics			
No. of Prior Disasters	1.52	.182	
Community Size	1.84	.066	
Community Growth	1.21	.277*	

*p < .05

**p < .01

***See Tables 3 and 4 for interview and questionnaire items and code categories used

****Beta weight of variable in final prediction model

Various mixes of these social factors were subjected to regression analysis. The final model accepted could not be improved by adding other variables. The five variable model explained *97 percent of the variation* in these perceptions. Thus, as perceived by these 62 local emergency managers, the most effective multiagency disaster responses reflected five social factors: 1) use of more coordination strategies by the emergency manager; 2) greater frequency of past disaster training and actual responses; 3) more frequent past

agency contact; 4) more lengthy forewarning; and 4) higher levels of domain consensus (Adjusted $R^2 = .965$; $F = 279.59$; $p < .001$).

Actual Effectiveness. Using the ten criteria proposed by Quarantelli (1997), “actual” effectiveness was assessed through an index that reflecting scores I assigned at the end of each interview (see discussion above). As would be expected, this measure was correlated with the perceptions of effectiveness shared by these managers ($r = .932$). But would the same social factors best predict these? The answers are revealed in Table 6.

Table 6: Factors That Constrained Actual Response Effectiveness

Area of Constraint	F	r	Beta****
Event Characteristics			
Length of Forewarning	3.09*	.385**	.207
Uncertainty of Forewarning	.01	.061	
Magnitude of Impact	.25	-.080	
Uncertainty of Impact	.72	.180	
Scope of Impact	.04	-.021	
Duration of Impact	2.58	.218	
Managerial Characteristics			
Length of Job Tenure	1.03	.031	
Years of Formal Education	.78	.018	
Age	.56	-.112	
Length of Time in Community	1.28	-.226	
Participation in Local Service Organizations	1.27	-.283*	-.188*
Service in Active Military	1.34	-.269*	
Service in National Guard or A/N Reserve	.55	-.148	
IAEM Member	.71	-.091	
Use of Managerial Strategies	2.22	-.313*	.013
Use of Coordination Strategies	6.81**	-.590**	-.362**
Agency Characteristics			
Agency Size	1.18	.129	
Number of Volunteers	1.11	.138	
Annual Budget	.99	.113	
Participation in Disaster Training	11.96**	-.603**	-.201
Frequency of Past Agency Contact	2.72*	-.314*	
Domain Consensus	12.58**	-.700**	-.396**
Community Characteristics			
No. of Prior Disasters	1.41	.240	
Community Size	1.44	.185	
Community Growth	2.76*	.371**	-.059

* $p < .05$

** $p < .01$

***See Tables 3 and 4 for interview and questionnaire items and code categories used

****Beta weight of variable in final prediction model

Clearly, as would be expected given the high degree of correlation between the two measures, most of the types of constraint appeared to be operative. Multivariate analyses, however, indicated that the best model was comprised of seven social factors. And despite its complexity, it only accounted for about two-thirds of the variation in this measure of “actual” effectiveness. (Adjusted $R^2 = .688$; $F = 15.52$; $p < .001$). This model documented that the *most effective community responses* were reflective of these seven factors: 1) high domain consensus; 2) more of the 26 coordination strategies were implemented; 3) lengthy forewarning; 4) more frequent participation in disaster training activities and actual responses; 5) local emergency manager participated in local community service organizations; 6) community had high rate of population growth; and 7) more of the managerial strategies were used by the local emergency manager during the past year.

Discussion

Analysis of the 62 disaster responses suggested six key observations that are critical in improving our understanding of emergency management. As such they set the stage for a broad theoretical interpretation that will serve as the intellectual foundation of this emerging profession (Drabek 1987).

First, within the U.S.A., *community disasters trigger emergent multi-agency networks*. It is through these networks that disaster relevant demands are accomplished, at least to the extent that they are.

Second, *specific managerial strategies have been documented* that can be used by effective emergency managers to nurture interagency relations, commitments, and trust prior to an event. Surprises will occur during the response to any disaster, hence, some types of improvisations always will be required. This conclusion reflects and further validates Kreps (1991) insightful analysis wherein preparedness and improvisation serve as the twin pillars of emergency management.

Third, *local emergency managers*, like executives of any other organization *make choices* that impact the future of their agency. Through the use of 26 coordination strategies they can effectively mobilize and guide the emergent multiagency networks. Indeed, it is such networks that define the focus of their profession. It is these EMONS that they must understand and manage.

Fourth, *the pattern of choice* exhibited by local emergency managers *is constrained* by past experiences and selected exigencies of the disaster event. Thus, areas of constraint that are comprised of specific social factors can be identified and measured. Once assessed through future comparative research designs, the consequences of strategic choice will be understood better. In turn, such understanding will provide the managerial guidance required for response effectiveness.

Fifth, *the models derived* from the present research *represent the necessary first step* toward the development of an empirically grounded theoretical foundation for the emergency management profession. The next steps in the development of this foundation are research studies similar to the present one whereby a more diverse and comprehensive data base is created. This data base must reflect many forms of diversity including a greater range of events, especially those precipitated by terrorists.

Sixth, and finally, *disaster response effectiveness*, at the community system level of analysis, remains a poorly understood concept. Its complexity, however, suggests that future examinations must define and assess both *process* and *outcome* formulations. Conceptual clarity and rigor along these lines is a legitimate expectation for the research community by emergency management professionals. Hence, such conceptual work must be viewed as a priority by disaster researchers.

Conclusions

The six key themes outlined above, plus the numerous regression models that documented various patterns of constraint within these 62 disaster responses, point toward three broad conclusions.

First, *local emergency managers must learn to think strategically*. A paradigm of strategic choice, focused on the behavioral reality of emergence, must define their approach to disaster management. For many, this is a significant paradigm shift. Past training focused on bureaucratic models and overly rigid notions of command, control, and authority must be put aside (Neal and Phillips 1995, Dynes 1994, Schneider 1992).

Second, for the emergency management profession to succeed, *the academic research community must provide the required knowledge base*. The theoretical foundations have been defined in broad, but sketchy profiles. Future research must provide more specifics and reflect the full range of risks, including terrorist attacks and threats, that confront communities. Once implemented within future emergency management education, the required paradigm shift can occur. Older training priorities and approaches can be abandoned and replaced with empirically grounded theoretical principles. For example, in contrast to “command and control” emphases, the more strategic and coordination focus discussed herein must gain primacy (see Dynes 1994).

Third, what is clear at this early point is the development of this emerging profession is that certain *processes*, namely key managerial and coordination strategies, can influence response effectiveness as do certain *structures*, like emergency operations centers. Use of these processes and structures define

the contours of the theoretical models that predict the form of the emergent multiorganizational networks that future disasters will precipitate. They also define the ongoing, pre-event activities through which various forms of disaster mitigation are accomplished. In short, such models define the theoretical foundations of the emerging profession of emergency management.

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