The ASPEP Journal 2001

ASPEP

AMERICAN SOCIETY OF PROFESSIONAL EMERGENCY PLANNERS

THE JOURNAL OF THE AMERICAN SOCIETY OF PROFESSIONAL EMERGENCY PLANNERS

ASPEP

The American Society of Professional Emergency Planners (ASPEP) is a professional organization of certified emergency managers dedicated to the advancement of knowledge about disasters and to the improvement of the practice of emergency management. ASPEP works toward these goals through continuing education, through professional development and exchange, and through the publication of an annual Journal.

THE ASPEP JOURNAL

The *ASPEP Journal* is published annually in the fall in time for release at the yearly conference of the International Association of Emergency Managers. The *Journal* is dedicated to the sharing of ideas, research, lessons, practice, and opinion and serves as a forum for all disciplines involved in emergency management. A formal call for papers is issued in early January of the year of publication. Articles or papers which will contribute to the goals of ASPEP are welcome.

A call for papers will be issued about January 1, 2002 for papers to be included in the 2002 *Journal* which will be published in November, 2002. The future may bring either electronic publication or more frequent print publication.

TYPES OF PAPERS

Articles or papers which will contribute to the advancement of knowledge and to improvement in the practice of emergency management are welcome. We encourage breadth of subject matter and depth of discussion.

Examples of subject matter which would be appropriate include:

> The state of the profession of emergency management: where it has been, where it is, and where it is going or should go.
>
> Research which will lead to a greater understanding of disasters, to their prevention or mitigation, to more effective response, or to better recovery practices. Research which will establish a base for further research.
>
> Discussions of particular emergency management problems, resources, or procedures which have not been well addressed in the past.
>
> New ideas which will lead to improved understanding and practice.

New ideas which will lead to improved understanding and practice.

Studies of events or exercises and the lessons which may be drawn from them that would be valuable to practitioners in a similar situation.

Programs which may be used by other emergency managers.

Practices which have proven successful.

Since the *Journal* is published only once a year, we prefer papers of lasting interest. You should be sure that the paper you start in January will still be of interest in November.

The *Journal* cannot accept papers which are advertisements or infomercials for particular products.

The usual length of our papers is between 1500 and 4500 words. Shorter articles may be published in the monthly *Bulletin of the International Association of Emergency Managers*. We recommend that you look at the earlier issues of the *Journal*. If you are in doubt contact us.

There will be a new editor in the coming year, but for further information in the interim, contact:

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The Journal of the American Society of Professional Emergency Planners

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TORNADO SHELTERS IN MOBILE HOME PARKS IN THE UNITED STATES

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INTRODUCTION

About 1 in 16 Americans lives in a mobile home and mobile homes account for 14% of all new housing in the United States (O'Hare and O'Hare 1993). In some states, including South Carolina, North Carolina, Mississippi, Alabama, and Florida, one in eight residents lives in a mobile home. Residents of mobile homes (also called manufactured homes) are at higher risk of injury or death during tornadoes than residents of site-built frame homes (American Meteorological Society 1997, AMS hereafter). Over the past 20 years, about 45% of deaths due to tornadoes have been among residents of mobile homes, yet only about 6% of the population lives in mobile homes. The mobile home generally offers less protection from wind-blown debris and less resistance to collapse or disintegration in strong winds than 'site-built' homes (AMS 2000, McDonald and Mehnert 1989). Mobile homes should be "evacuated for more sturdy shelter if a tornado is imminent" or, if no shelter is available and there is enough warning lead-time, "it might be best to evacuate in a vehicle to avoid an approaching tornado or to reach a sturdy shelter" (AMS 2000). There are also recommendations to evacuate a mobile home when severe thunderstorm warnings (FEMA 1986) or high wind warnings (AMS 1997) are issued.

In 1990, 43% of mobile homes in the United States were in mobile home parks (O'Hare and O'Hare 1993). Since 86% of the mobile homes located in parks are on rented lots, there is little opportunity for residents to install personal underground storm shelters. Community storm shelters in mobile home parks would give the opportunity for mass evacuation and shelter when a tornado warning is issued. Langston (1977) found that in a 13-state area of the South and eastern Midwest 34% of mobile home parks had a storm shelter. The American Meteorological Society (1997) policy statement on mobile homes and severe windstorms urged that "adequate shelters be constructed at all mobile home parks." The American Meteorological Society (2000) policy statement on tornado preparedness and safety recommended "requiring and providing shelters in mobile home communities" and noted that "underground shelters are best and should be in place in every mobile home community." Calls for storm shelters in mobile home parks have been made for many years in several venues (for example AMS 1975, Golden and Snow 1991, National Weather Service 1998).

In spite of these suggestions and efforts, the current prevalence and characteristics of tornado shelters in mobile home parks in the tornado-prone regions of the United States is unknown. The purpose of this research is to assess the percentage of mobile home

Table 1: Characteristics of Mobile Home Parks Surveyed

	State											
	All 11	SC	FL	GA	AL	MS	AR	OK	KS	MO	IL	IN
Average Number of Homes in the MHP	131	107	229	120	86	99	64	91	145	124	188	173
MHP Setting (%)												
Rural	30	35	21	35	27	20	25	39	22	40	36	26
Small Town	35	32	46	35	45	23	40	30	38	28	32	40
Medium City	21	18	21	22	18	37	22	18	12	14	20	26
Large City	14	15	12	8	10	20	13	13	28	18	12	8
Demographics (%)												
Young People	4	4	0	5	14	10	5	3	2	0	0	1
Families	14	14	16	23	9	21	3	11	18	8	17	17
Retirees	14	12	65	3	15	8	22	11	5	12	3	2
Mixed	68	70	19	69	62	61	70	75	75	80	80	80
Predominant Race (%)												
White	39	19	51	19	29	31	56	44	32	61	40	36
Black	3	15	0	9	4	8	0	0	0	5	0	0
Hispanic	2	0	0	0	2	1	2	2	6	0	4	2
Mixed	56	66	49	72	65	60	42	54	62	34	56	62
Income Level (%)												
Low	36	38	20	41	35	50	33	25	40	41	45	30
Middle	60	62	65	56	65	50	64	71	48	51	55	70
High	4	0	15	3	0	0	3	4	12	8	0	0
Average Lot Rental ($/mo)	164	145	249	161	136	138	110	133	160	161	222	182

parks (MHPs) that have a designated tornado shelter, the characteristics of the designated shelters, and to explore the data for regional differences and for relationships with demographics of the MHP residents. Our goal is to provide information that is useful for tornado preparedness planning, emergency management, and local zoning and construction codes and to improve tornado preparedness and safety for the most vulnerable population - mobile home residents.

METHODS

Eleven states in the central and southeastern United States were chosen for study (Figure 1). These states were part of our larger project in which we investigated the tornado shelter-seeking behavior of and shelter availability for mobile home residents (Schmidlin et al 2000). A brief survey (available from the authors) was designed to assess the presence of a tornado shelter in the mobile home park (MHP), characteristics of the shelter, and demographics of the park with respect to lot rental, race, age, and income. A list of MHPs in each state was obtained from the Verizon Yellow Pages web site (http://yp.superpages.com). From those lists, a random sample of 40 to 50 MHPs was drawn from each state. The offices of the MHPs were contacted by telephone during July and August 2000 and the respondents were asked to participate in the survey by answering the questions regarding MHP tornado shelter availability and characteristics of the park and shelter. Respondents were asked to use their best judgement in providing the answers. If a respondent refused to participate, the next MHP on the list was called. The percentage of MHPs with shelters was determined for each state. The characteristics of shelters were summarized by state and region, then compared among states and regions, and summarized with respect to characteristics and demographics of the MHP.

RESULTS

General and Demographics

Surveys were completed for 480 MHPs in 11 states (Figure 1). This was 8% of the MHPs listed in the Yellow Pages source for those 11 states. Demographic characteristics of the MHPs are shown in Table 1. The average number of mobile homes in the MHPs was 131, ranging from an average of 64 in Arkansas to 229 in Florida. This was considerably larger than the median of 66 mobile homes in Langston's 1977 study. Most MHPs were in small town (35%) or rural (30%) settings, as described by the respondents. Most MHPs (68%) had residents with 'mixed' age groups, except in Florida where 65% of MHP residents were predominately retirees. The most common race of MHP residents in all states was 'white', although the most common response (56%) was that the MHP was racially 'mixed.' The income of MHP residents was commonly given as middle (60%) or low (36%). (A response of 'low-middle' or 'high-middle' income was classified as 'middle' in Table 1) Average monthly MHP lot rental was $164, ranging from $110 in Arkansas to $249 in Florida.

Table 2: Characteristics of Tornado Shelters in Mobile Home Parks[a]

	All 11	Deep South	Plains	Midwest	Florida
% with Shelter	33	14	78	29	27
% with Shelter Below Ground	20	6	63	15	0
% of Shelters Below Ground	59	41	81	50	0
% of Above-Ground, Large Windows	46	62	23	39	73
Usual Use of Shelter:					
Shelter Only	59	27	90	37	27
Commercial / Office	18	32	3	22	64
Storage	7	27	1	6	9
Laundry	6	5	1	14	0
Other	10	9	4	21	0
Ave MHP Total Shelter Size in m^2	157 (66)	100 (8)	97 (34)	200 (22)	929 (2)
Ave m^2/Person Claimed as Capacity	1.2 (60)	1.3 (7)	0.8 (3.1)	1.6 (20)	2.7 (2)
Average Capacity of Shelters	197 (135)	118 (21)	241 (60)	158 (43)	256 (11)
% Locked at Some Time	55	59	43	66	64
% Handicapped Accessible	65	68	50	75	100
Ave Maximum Metres to Shelter	260 (135)	229 (20)	223 (62)	325 (46)	248 (7)
% of MHPs Recommending Where Residents Go	59	41	90	58	67
Location Recommended:					
Shelter in MHP	58	36	85	54	40
School / College	14	27	6	10	20
Commercial Building	8	13	1	12	0
Church	5	3	0	8	20
Ditch / Ravine	4	6	0	7	0
Fire Station / Hospital	3	5	1	5	0
In / Under Trailer	1	3	0	1	0
Other Building Outside MHP	6	6	6	4	20
Below Ground Shelters Only					
Ave Capacity of Below-Ground Shelters That Have Known Capacity	190 (80)	112 (9)	228 (46)	149 (25)	– (0)

Note a. Selected sample sizes shown in parenthesis. See Annex 1 for statistics by State.

State and Regional Differences

The percentage of MHPs with tornado shelters, as defined by the telephone respondents, varied widely among states from 12% in South Carolina and Georgia to 80% in Kansas and 76% in Oklahoma (Annex 1 and Figure 2). The overall average among the 11 states was 33%. This is nearly identical to the 33.7% reported by Langston (1977) for 13 states in the South and eastern Midwest, although Langston did not report percentages by state. The percentage of MHPs with a below-ground tornado shelter was 20%, ranging from 0% in South Carolina and Florida to 66% in Oklahoma and 60% in Kansas (Figure 3). This initial disparity among states in the percentage of MHPs with shelters and in the percentage of below-ground shelters led us to examine regional patterns. From those observations, we divided the study area into the four regions shown in Figure 1. The four 'Deep South' states (South Carolina, Georgia, Alabama, and Mississippi) had similar characteristics, as did the two Plains states (Oklahoma and Kansas). Four states (Indiana, Illinois, Missouri, and Arkansas) had characteristics intermediate between the Deep South and Plains; these were Midwest 'transition' states. Florida was distinct among the southern states and was therefore considered a separate region.

As viewed regionally, the percentage of MHPs with a tornado shelter ranged from 14% in the Deep South to 78% in the Plains (Table 2). The Midwest 'transition' region and Florida were intermediate with 29% and 27%, respectively. The percentage of MHPs with a below-ground shelter was 6% in the Deep South, 63% in the Plains, 15% in the Midwest and 0% in Florida. In the MHPs with a shelter, 59% of the shelters were below ground. This is greater than the 47% of shelters below ground reported by Langston (1977), due in part to Langston's exclusion of the Plains where we found underground shelters to be most common.

Shelter Characteristics

Our previous field observations indicated that the structure called the 'tornado shelter' in MHPs is often a building such as the MHP office or a building used for storage, a pool house, or community building (Schmidlin et al 1998). These buildings, although perhaps more protective than a mobile home during severe winds, have disadvantages of being above-ground, having large windows, and having large-span roofs in large rooms. In addition, the buildings may have limited capacity because of their primary use, may be locked at certain hours or on certain days, and may not be accessible to the physically disabled.

Several survey questions addressed these issues. Nearly half (46%) of the above-ground shelters had large windows or large numbers of windows. The greatest percentages of above-ground shelters with large windows were in the Deep South and Florida (62% and 73%, respectively) while the lowest percentages were in the Midwest and Plains (39% and 23%, respectively). Most (90%) shelters in the Plains were used *only* as shelters, but shelters were used for some other purpose at 73% of the MHPs in the Deep South and in Florida and at 63% of the MHPs in the Midwest. These alternative uses included offices, storage rooms, laundry rooms, pool houses, club houses, and recreation rooms. More than half (55%) of MHP shelters are locked at some time and 35% are not handicapped accessible. Langston (1977) found, similarly, that 50% of shelters were locked at some time. All Florida MHPs with shelters had handicapped accessible shelters, perhaps due to the older population of the MHPs and the fact that all surveyed MHP shelters in Florida were above-ground structures.

The average area of the designated tornado shelters in MHPs was 157 m^2 (1690 ft^2), as estimated by the respondents. Average total capacity claimed for the tornado shelters was 197 people, ranging from 118 people in the Deep South to 256 in Florida and 241 in the Plains. The overall average shelter area per capita for the 60 MHPs that provided both a shelter area and shelter capacity was 1.2 m^2 (12.9 ft^2) per person. Average capacity of below-ground shelters in MHPs was 190 people, ranging from 112 people in the Deep South to 228 people in the Plains. The average estimated distance between the MHP shelter and the mobile home farthest from the shelter was 260 m (853 ft), ranging from 223 m (732 ft) in the Plains to 325 m (1066 ft) in the Midwest. Distance affects the time required to reach shelter and perhaps the likelihood that the shelter will be used and is largely a factor of the size of the MHP and number of shelters. FEMA (1986) recommended that mobile home occupants should be required to travel no more than 600 ft (183 m) from their home to a storm shelter.

Information Given to Residents

Tornado safety may be increased if MHP managers inform residents about the location and availability of tornado shelters within the MHP or, if there are no shelters in the MHP, the location and availability of the nearest shelters outside of the MHP. We asked whether the MHP staff informed residents about where to go in case of a tornado warning. Overall, 59% of MHPs gave residents this information, ranging from 41% in the Deep South to 90% in the Plains. The Midwest (58%) and Florida (67%) were again intermediate in response.

The most commonly recommended location for tornado shelter in each region was a 'shelter' inside the MHP. As reported above, some of these were underground tornado shelters, while at other MHPs the 'shelter' was an above-ground office, club house, pool house, or storage building. Among the 59% of MHPs that made a recommendation for shelter, 58% of those recommended a shelter *within* the MHP, 14% in a school or college, 8% in a commercial building (mall, grocery, motel, etc), 5% in a church, 3% in a fire station or hospital, and 6% recommended an unspecified building outside of the MHP. Four percent of MHPs recommended that residents seek shelter in a ditch, creek, or ravine, and 1% recommended that the residents seek shelter in the bathroom of the mobile home or underneath the mobile home. No MHPs in the Plains or in Florida recommended seeking shelter within or beneath the mobile home, or in a ditch, creek, or ravine, while 9% of MHPs in the Deep South and 8% in the Midwest made those recommendations.

Demographics and Shelter Availability

Analyses were conducted to determine whether there were differences in shelter availability based on racial or income characteristics of the MHPs. There were 15 MHPs with >50% of the residents who were Black or Hispanic. Sixty percent of these were characterized as low income MHPs, compared to 36% of the overall sample. Only 20% of the predominately Black/Hispanic MHPs had a tornado shelter and only 7% had an underground shelter, smaller percentages than the overall sample of 480 MHPs in 11 states (33% and 20% respectively). Nine of the 15 Black/Hispanic MHPs (60%) were in the Deep South, however, while only 33% of the overall sample of MHPs were in the Deep South. The percentage of Black/Hispanic MHPs with tornado shelters and the percentage with below-ground shelters, 20% and 7%, are similar to those of all MHPs surveyed in the Deep South, 14% and 6%, respectively. The sample of MHPs where >50% of the residents are Black or Hispanic was small (3% of all MHPs) so results should be viewed with caution, but there does not seem to be a racial bias in the presence of tornado shelters.

About one-fourth of MHPs were classified as 'low' income by the respondents. Of these low income MHPs, 22% had a shelter and 15% had an underground shelter, both somewhat lower than the overall percentages of 33% with shelter and 20% with underground shelter. In the Deep South, the percentages of low income MHPs with shelter (12%) and with underground shelter (7%) were about the same as the percentages of all MHPs with shelter and underground shelters (14% and 6%, respectively). This held true also for the Midwest. In the Plains, however, the percentage of low income MHPs with shelter (45%) was less than the overall percentage (78%) with shelter. It appears that inequity in the presence of tornado shelters based on income is not general in the states studied, but may occur in the Plains states of Oklahoma and Kansas.

DISCUSSION

The Plains (OK, KS) region has the best facilities for MHP tornado shelters. In this region, 78% of MHPs reported a tornado shelter and 81% of these shelters were underground. The Plains had the smallest percentage (23%) of above-ground shelters that had large windows and the largest percentage of shelters used exclusively as shelters (90%). Yet, even in the Plains, 22% of MHPs do not have tornado shelters and 37% do not have a below-ground shelter. Access to tornado shelters on the Plains may be hindered by shelters being locked at some times (43%), by lack of handicapped accessibility (50%), and by distance between the shelter and mobile homes in the MHP.

The Deep South (SC, GA, AL, MS) had the worst facilities for tornado shelters in MHPs. Only 14% of MHPs in the Deep South had any tornado shelter and only 6% had a below-ground shelter. Most (62%) of the above-ground shelters in the Deep South had large windows and 73% of shelters in the Deep South had a primary use other than as a tornado shelter. Access to shelter in the Deep South may be hindered by the shelter being locked at some times (59%), by lack of handicap accessibility (32%), and by distance between the shelter and mobile homes.

The Midwest 'transition' region (IN, IL, MO, AR) was intermediate between the Plains and Deep South in most measures of shelter availability and characteristics. Unfortunately, only 29% of MHPs in the Midwest had any tornado shelter and only 15% had below-ground shelters. About one-quarter (27%) of Florida MHPs had a tornado shelter but all of these were above-ground, 73% had large windows, 64% were locked at some times, and 73% were used primarily for something other than a shelter, typically as a club house, pool house, or office in the MHP.

Among the MHPs in this study, 41% gave no advice to residents about what actions to take when a tornado threatens. This may leave residents, especially those new to an area, vulnerable and uncertain of where to go when severe weather threatens and may lead to critical delays in evacuating the mobile home. One-third (32%) of MHPs recommended that residents leave the mobile home and seek tornado shelter in a sturdier building within the MHP. One-fifth (20%) recommended that residents seek shelter in a building outside of the MHP. Some of these recommended shelters, such as fire stations and hospitals, may offer access at all hours and on all days, however, most recommended shelters outside of the MHP, such as schools, colleges, churches, malls, grocery stores, and city hall, are likely to be locked at night and, in some cases, on weekends and holidays. Several MHPs in the Deep South and Midwest recommended that residents go outdoors into a ravine, creek, or ditch. Our previous research found that mobile home residents are very reluctant to go outdoors and lie down during a tornadic thunderstorm (Schmidlin et al 1998).

County emergency management agencies can provide a valuable service by evaluating the tornado shelter options at all MHPs in their county and providing written advice to MHP residents, at least annually, on the locations available for shelter. Hospitals, churches, and public facilities such as police and fire stations could notify MHP residents near their facility about their hours of operation and access during severe weather, especially at night.

Owners of MHPs are reluctant to install tornado shelters due to the costs of the structure, to maintenance and vandalism problems, and to fear of liability if the shelter does not perform as advertised to the residents. Designating an existing room or building used for another purpose in the MHP as the 'tornado shelter' is relatively easy but the designated building is commonly above-ground with large windows and may be locked when not directly supervised. Underground shelters in MHPs may have water seepage and deterioration, especially in the warmer, wetter southern states. A shelter that is not locked may be abused as a hang-out or unsupervised party area, but if it is locked, then the access to residents may be limited during severe weather.

This research in 11 central and southern states has shown a lack of tornado shelters in MHPs and many limitations to the use and efficacy of the existing shelters. There are striking regional differences in shelter availability in MHPs. Until the shelter availability is improved in MHPs, especially in the Deep South and Midwest, tornado preparedness and warning programs must acknowledge the lack of tornado shelters and make recommendations for the most protective action for residents of mobile homes who do not have a nearby tornado shelter.

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NOTES

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Figure 1

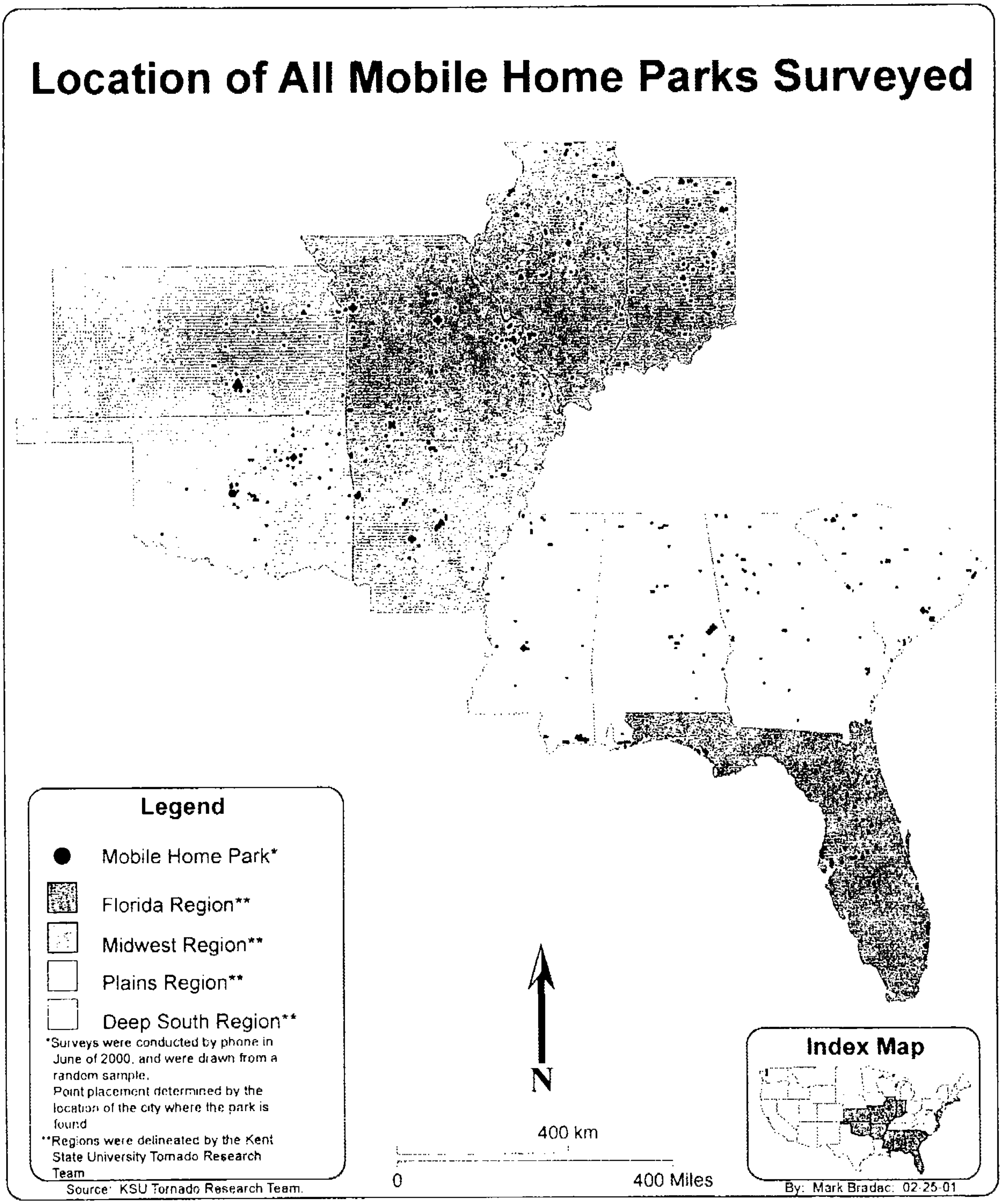

Location of All Mobile Home Parks Surveyed
Legend
Mobile Home Park*
Florida Region**
Midwest Region**
Plains Region**
Deep South Region**
*Surveys were conducted by phone in June of 2000, and were drawn from a random sample.
Point placement determined by the location of the city where the park is found
**Regions were delineated by the Kent State University Tornado Research Team
Source: KSU Tornado Research Team.
N
400 km
0
400 Miles
Index Map
By: Mark Bradac 02-25-01

Figure 2

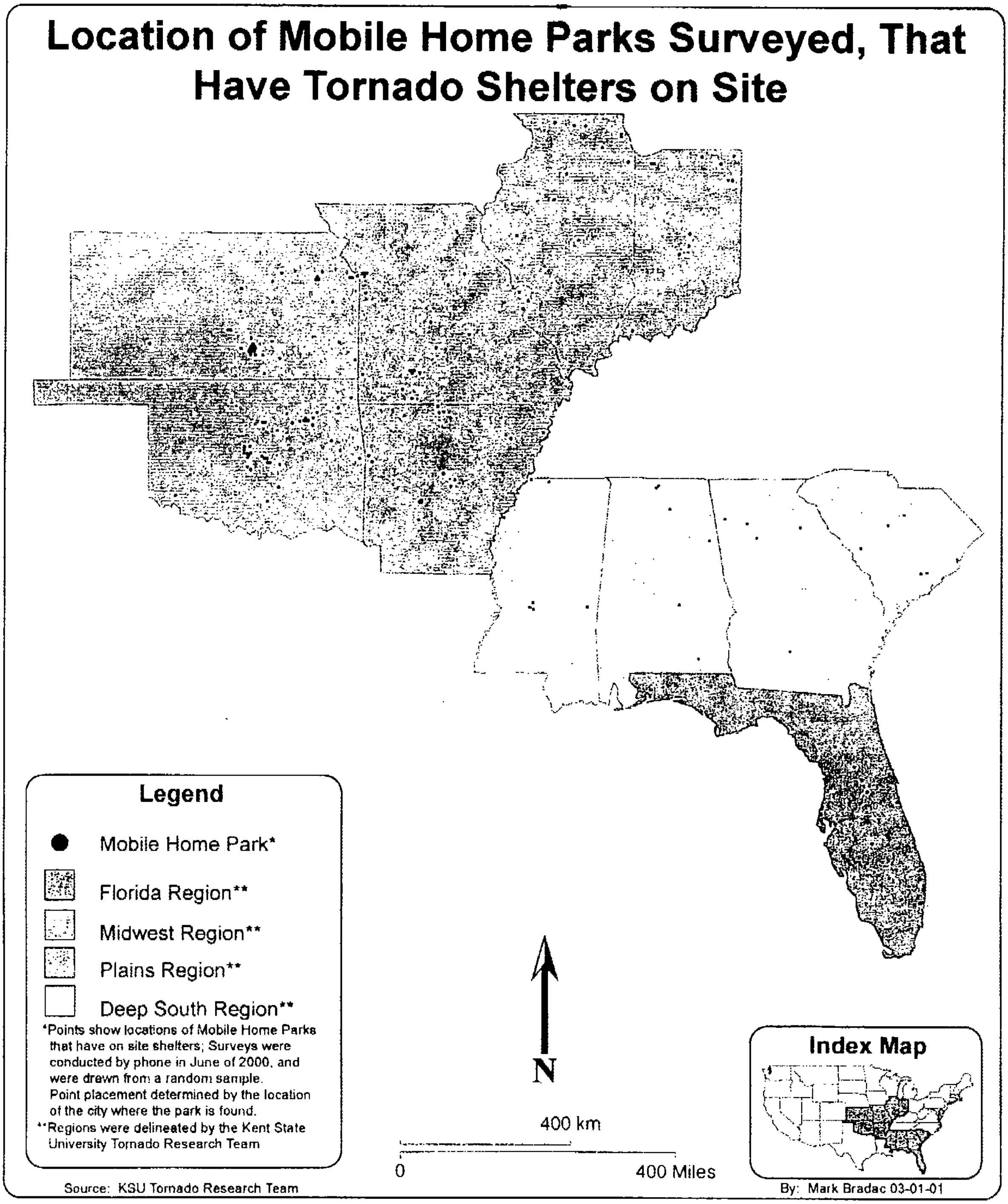
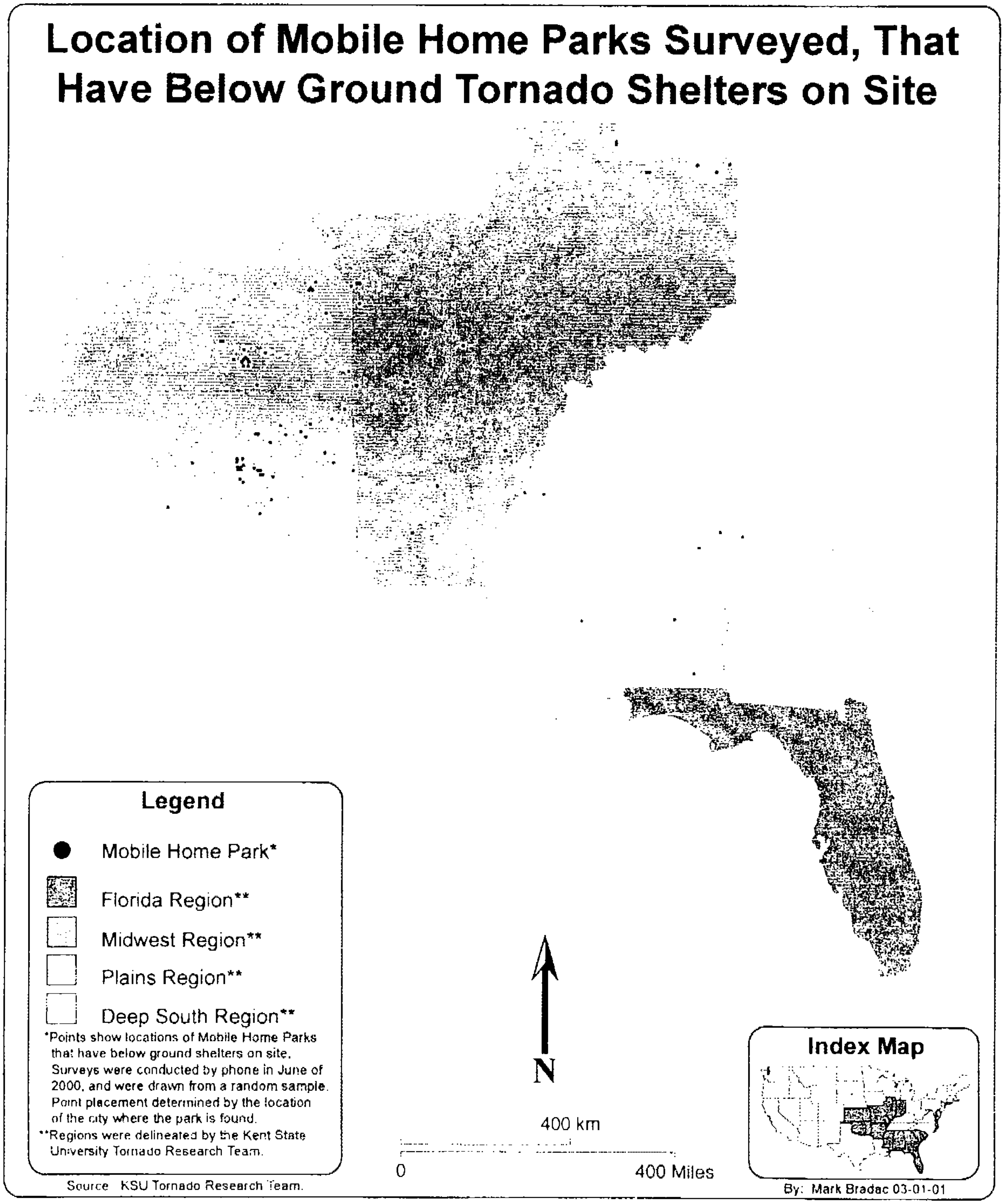

Location of Mobile Home Parks Surveyed, That Have Tornado Shelters on Site
Legend
Mobile Home Park*
Florida Region**
Midwest Region**
Plains Region**
Deep South Region**
*Points show locations of Mobile Home Parks that have on site shelters; Surveys were conducted by phone in June of 2000, and were drawn from a random sample.
Point placement determined by the location of the city where the park is found.
**Regions were delineated by the Kent State University Tornado Research Team
N
400 km
0
400 Miles
Index Map
Source: KSU Tornado Research Team
By: Mark Bradac 03-01-01

Figure 3



Location of Mobile Home Parks Surveyed, That Have Below Ground Tornado Shelters on Site
Legend
Mobile Home Park*
Florida Region**
Midwest Region**
Plains Region**
Deep South Region**
*Points show locations of Mobile Home Parks that have below ground shelters on site. Surveys were conducted by phone in June of 2000, and were drawn from a random sample. Point placement determined by the location of the city where the park is found.
**Regions were delineated by the Kent State University Tornado Research Team.
Source KSU Tornado Research Team.
N
400 km
0
400 Miles
Index Map
By: Mark Bradac 03-01-01

Annex 1: Characteristics of Tornado Shelters in Mobile Home Parks by State[a]

	All 11	SC	FL	GA	AL	MS	AR	OK	KS	MO	IL	IN
% with Shelter	33	12	27	12	15	15	35	76	80	40	22	22
% with Shelter Below Ground	20	0	0	5	7	10	15	66	60	25	8	10
% of Shelters Below Ground	59	0	0	40	50	67	43	87	75	65	36	45
% of Above-Ground, Large Windows	46	40	73	67	67	100	12	40	12	29	71	50
Usual Use of Shelter:												
Shelter Only	59	0	27	20	50	33	78	89	91	45	18	9
Commercial / Office	18	60	64	20	17	33	0	5	0	20	36	27
Storage	7	20	9	40	17	33	0	0	3	10	0	9
Laundry	6	0	0	20	0	0	11	0	3	15	18	9
Other	10	20	0	0	17	0	11	5	3	10	27	45
Ave MHP Total Shelter Size in m^2	157 (66)	186 (1)	929 (2)	96 (3)	144 (2)	21 (2)	42 (4)	53 (17)	141 (17)	172 (12)	479 (3)	243 (3)
Ave m^2/Person Claimed as Capacity	1.2 (60)	1.9 (1)	2.7 (2)	1.2 (2)	1.4 (2)	1.0 (2)	1.0 (4)	0.9 (15)	0.7 (16)	1.7 (10)	3.1 (3)	0.9 (3)
% of Shelters That Are One Large Room	83	40	91	60	100	50	64	97	91	90	64	73
Average Capacity of Shelters	197 (135)	82 (5)	256 (11)	112 (4)	155 (6)	116 (6)	66 (9)	109 (31)	383 (29)	141 (16)	239 (9)	198 (9)
Average #mh in MHPs That Have Known Shelter Capacity	152	220	254	57	121	137	91	99	162	151	269	161
Capacity as % of MHP Population (Pop = mh x 2.9)	44	13	35	68	44	29	25	38	81	25	31	42
% Locked at Some Time	55	80	64	40	67	50	43	26	62	65	73	91
% Handicapped Accessible	65	100	100	60	83	33	57	32	72	90	73	73
Ave Maximum Metres to Shelter	260	302	248	280	169	165	172	238	205	297	496	410
% of MHPs Recommending Where Residents Go	59	27	67	42	52	40	50	86	95	74	58	50
Below-Ground Shelters Only												
Ave Capacity of Below-Ground Shelters That Have Known Capacity	190 (80)	— (0)	— (0)	100 (2)	232 (3)	29 (4)	44 (5)	121 (26)	368 (20)	123 (13)	326 (4)	198 (3)

Annex 1 Continued

	All 11	SC	FL	GA	AL	MS	AR	OK	KS	MO	IL	IN
Average #mh in MHPsThat Have Known Below-Ground Capacity	134	—	—	45	115	78	126	87	154	160	364	156
Capacity of Below-Ground Shelters as % of MHP Population (Pop = mh x 2.9)	50	—	—	77	70	13	12	48	82	27	31	44
Ave Size in m^2 of Below-Ground Shelters in MHPs with Known Capacity	91 (41)	— (0)	— (0)	125 (2)	111 (1)	21 (2)	31 (3)	44 (12)	141 (11)	115 (9)	— (0)	139 (1)
Ave m^2/Person Claimed as Capacity in Below-Ground Shelters	1.0 (41)	— (0)	— (0)	1.25 (2)	0.93 (1)	0.96 (2)	0.62 (3)	0.85 (12)	0.71 (11)	1.72 (9)	— (0)	0.46 (1)

Note a. Selected sample sizes shown in parenthesis. See Table 2 for statistics by Region.

HAZARD VULNERABILITY AND CONSEQUENCE ANALYSIS: USING THE TECHNOLOGY

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INTRODUCTION

Public, private, and non-profit organizations have been dramatically impacted in the past few years by technology. The communication within and between organizations and their units has increased. The use of computers, programs, and networks has allowed organizations to improve in quality, and productivity. At the same time, organizations in the public, non-profit, and business sectors are increasingly aware of the potential impact disasters have on communities. Information tools and technology have been impacting organizational response to the threat of hazards, enhancing the organizational capacity to plan, respond, mitigate and recover from disasters. The following is a discussion of tools and technology for hazards vulnerability and consequence analysis that are available to public, private, and non-profit organizations. It also examines issues that may be present in the use of technology to understand hazards and their impacts. Recommendations on how to integrate technology into public, private, and non-profit operations are provided.

Many communities face hazards including hurricanes, flooding, high winds, tornadoes, wildland fires, and exposures from accidents involving hazardous substances. Even though most natural and man-made disasters occur independently, they could occur simultaneously. Some of the following questions arise:

> What tools and resources may be available to national, state, or local organizations for understanding the nature of hazards?
>
> How could these tools and resources be of help in the preparation for, response to, and mitigation of the adverse affects of disasters?
>
> How might public, nonprofit, and private organizations be affected by the use of technology in a disaster?
>
> What steps could be taken to minimize problems associated with the use of technology in emergency planning and response activities?

The emergence of the intelligent city in the latter part of the 20th Century and the beginning of the 21st Century may dramatically transform our capacity to understand the potential and predicted impact of hazards. Computing, modelling, remote sensing, and telecommunications technologies will combine their resources and utility to impact all elements of decision making by those involved in emergency and risk management (Stalberg 1994). Mobile wireless and wire networks may serve as the backbone for communications and offer greater access worldwide to hazard technologies currently available at a very high cost and in limited situations.

High-speed communications networks are providing a means of greater interconnectedness of public, private, and non-profit organizations. Traditional organization boundaries separating their operations may be impacted by technology tools and resources. In addition, with greater interconnectedness, the technology should enhance our capacity to analyze more complex hazards and make information more available to decision-makers at the national, state, and local level.

HAZARD ANALYSIS

In an effort to improve emergency planning and formulate public policies that support economic development and a sustainable environment, policy makers are emphasizing the importance of effective hazards analysis. Hazards analysis is a broad term to include hazard identification, vulnerability and consequence assessment, and risk assessment. An understanding of the nature and consequences of a hazard are critical in making strategic decisions associated with land use limitations, economic planning, and emergency response.

A hazard is an event or physical condition that has the potential to create loss (causing fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, etc) as it impacts the environment (and society), a community, or business. Critical to understanding a hazard is its identification and characterization. Hazard identification is thus associated with a process of defining and describing a hazard, including its physical characteristics, magnitude and severity, probability and frequency, causative factors, and consequences including locations and area affected (FEMA 1997). .

Vulnerability assessment includes an examination of the potential for loss or the capacity to suffer harm from a hazard as applied to individuals, society, or the environment (Mitchell 1997). This is in contrast to the concept of consequence assessment which examines the predicted adverse impact of a disaster that can be quantified by some unit of measure (often in economic or financial terms) including injuries and losses of life, property, environment, and business.

FRAMEWORK FOR TECHNOLOGY

Public, private, and non-profit agencies and organizations have a variety of tools that are available to assist in the hazard analysis process. Some of the tools are well suited to take advantage of complex modelling programs and to display areas that may be impacted by a specific hazard scenario. Some modelling programs have the capacity to estimate the consequences of a disaster to the natural, built, and human environments. A few examples of the types of tools that aid in the hazards analysis process illustrate current and future capabilities of the technology.

It should be noted that the pace in which the technology is impacting communities, states, and national organizations is increasing, requiring anyone involved in dealing with disasters to learn fast and keep on learning. The technology connection as a useful set of tools is growing and providing us with a means to assist in decision-making. Technology is also used to process information and to support activities which help communities minimize the adverse impact of natural and technological disasters.

The technology tools may be set into four major areas including the technology infrastructure, program applications, information systems, and organizational dynamics. How our public, private, and non-profit systems address these areas may impact our ability to minimize the adverse impact of disasters on our economy, community life, and the environment.

Technology Infrastructure

The technology infrastructure provides the foundation for bringing program applications to public, private, and non-profit institutions. The technology infrastructure involves powerful personal computers, digital telephones, satellite imaging devices, and environmental sensors. Networks, both line and wireless, allow data transmission speeds to transfer gigabyte and terabyte data including voice, video, and text from mobile and stationary locations. The technology infrastructure also includes the collection of data from remote and direct sensors, geo-positing devices for pinpointing locations (shelters, incidents, facilities, schools, hospitals, nursing homes, and schools), and wire-line and wireless networks.

Computer technology has been enhanced so that many of the most complex modelling programs can operate on a personal computer in a reasonable time period. Further, remote access capabilities are possible using high speed fiber-optic communications lines which link computers running complex models with users. Even where these lines do not exist, the use of the Internet allows access to rich data sources.

Louisiana State University (LSU) has been a significant player in bringing remote sensing technology to Louisiana communities. Weather data and satellite images are obtained by LSU units by satellite downlinks and communicated to the state operations center. The Earth Scan Laboratory (Huh 1999) and NOAA's Regional Climate Center (Robbins 1999) at Louisiana State University provide real time access to remote sensing satellite imagery using this communication link so that state and local officials are able to visualize the development of severe weather patterns. In addition, the images may also define the extent of rangeland fires or chemical accidents and their potential impact on Louisiana communities. For the emergency management community, the Earth Scan Laboratory and the Regional Climate Center may be able to clarify heavy rainfall in the coastal region and inland areas of the state.

The placement of direct sensors in water features through the United States Geological Survey river gauge system provides real time data for determining river elevation (Wall

1995; Kiester 1997). The remote and direct-sensing tools provide a means of predicting heavy areas of rain which gives more realistic data for flood modelling.

Program Modelling Applications

Technology is also impacting emergency management through program applications that model natural and technological disasters, provide user-friendly communications software, and offer computer decision support systems. Computer programs make it easier for managers to communicate with one another, access data, and analyze information. Geo-positioning systems (GPS) and geographic information systems (GIS) merge current database tables to graphic intelligent maps. Technology for tracking and modelling storms allows for more effective preparedness activities including sheltering, evacuation, and damage assessment. Programs for automated forecasts, modelling, and digital libraries are used to support training, planning and mitigation activities. Access to real time databases is now available to support these simulation programs.

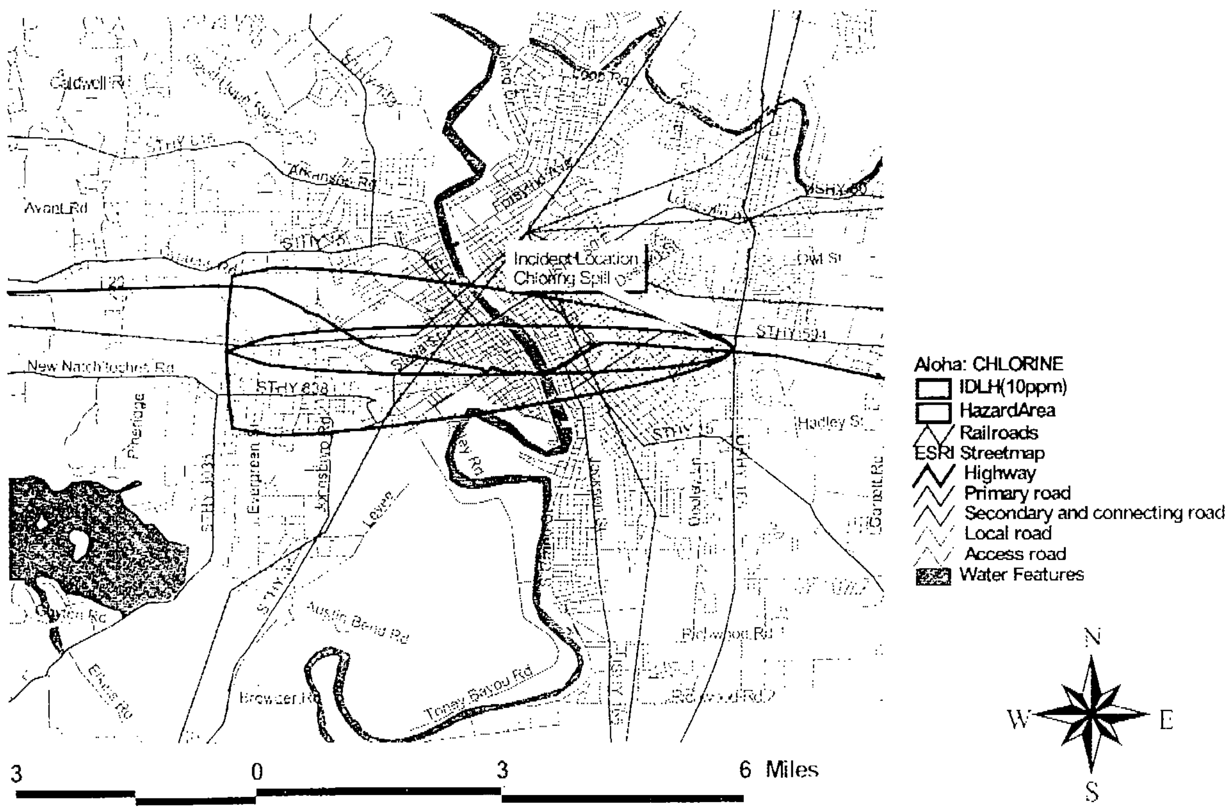
Several modelling and decision support systems are available to examine the nature and extent of hazard events such as floods or hurricanes. The outputs from these models may be made available over the Internet and used to support economic, environmental, and public safety decisions. Real time support of these activities may be possible using modelling programs and technical experts. The following describes some of the modelling resources available to organizations.

Air Modelling Hazardous Chemicals. Accidental releases of hazardous substances into the air, water, and the ground may be simulated in modelling programs such as ARCHIE, ALOHA, DEGADUS, HPAC, D2PC, and SLAB. They provide users with critical information such as the geographic areas that could be affected by spills or releases; most of the programs describe the geographic area impacted by the spill and concentration levels at various points. The models allow for simulations of tanks, pipelines, and containers at fixed sites as well as for the transport of hazardous chemicals by motor transport, rail, or water.

An example of outputs from air modelling program used to determine risk zones for the transportation of hazardous chemicals or tanks at fixed sites is shown in Figure 1. Linking the buffer risk-zone created by a modelling program to a geographic information system is a critical component in hazards analysis. Clarifying the potential area impacted in a specific scenario can provide the basis for identifying the number of residents and businesses in the plume. Figure 1 used Areal Locations of Hazardous Atmospheres (ALOHA) as a modelling program to examine the area affected by a chemical leak from a 2000 lb tank.

The ALOHA program developed by the National Oceanic and Atmospheric Administration (NOAA) and the United States Environmental Protection Agency (EPA) allows the user to define an accident scenario as illustrated above. The hazard buffer zone created by ALOHA also defines the chemical concentration at a specific point; this information could be used to determine the number persons at risk from an incident outside and inside buildings in the risk zone. ALOHA thus provides an example of a

Figure 1: Vulnerability Zone of Chlorine Chemical Spill in a GIS

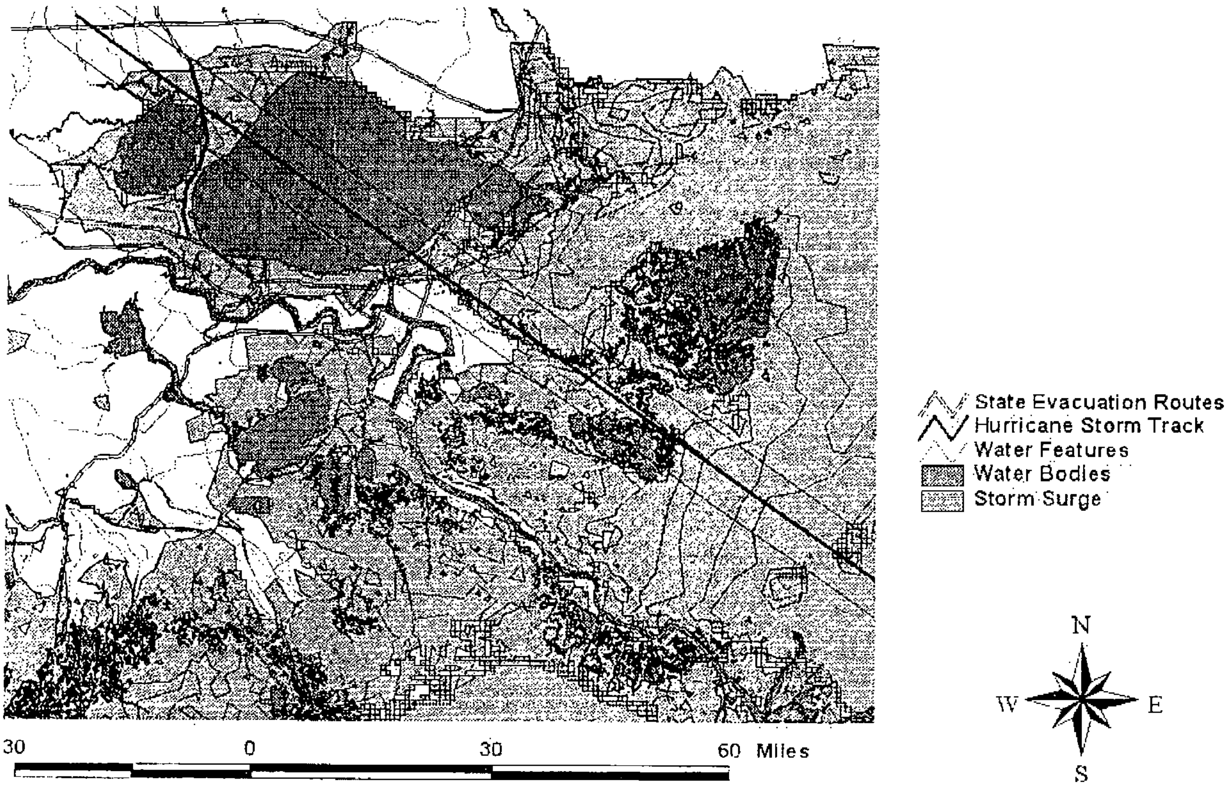


modelling tool for use in vulnerability assessment and to a limited degree in consequence assessment.

Hurricane Wind and Storm Surge Modelling. Complex hurricane simulation models can provide hurricane storm surge and wind modelling capabilities. The Water Resources Natural Engineering Laboratory at Louisiana State University has the capacity to simulate past storms or use current weather conditions to clarify the potential effects of a storm. Outputs from the model are generated to reflect both the storm surge inundation area and severe wind bands. This data may be used by decision makers to determine potential problems in road and bridge closures, in evacuation routes evacuations, and in selection of mass care and special needs shelters. Since the model outputs can only show the area impacted by high winds and the depth of the storm surge, it is not possible to determine the impact that a storm will have on specific buildings, roads, bridges or levees. This type of model is limited to vulnerability assessment and is not appropriate for use in determining the actual consequences of a specific event.

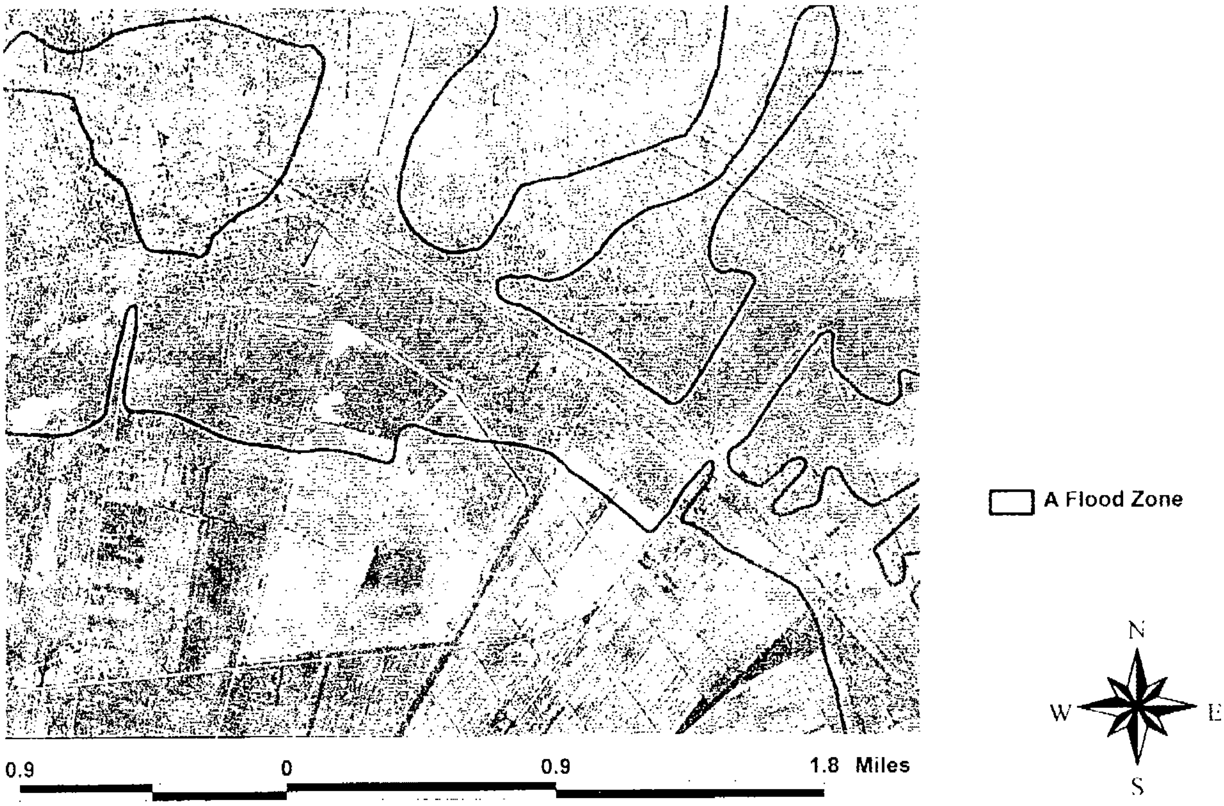
A critical component of the data generated from complex hurricane modelling efforts is the determination of storm surge depth. Figure 2 provides an example of the model output for hurricane storm surge. Water depth from a category four hurricane is identified and may be used in a GIS to identify the number and characteristics of structures impacted by a storm scenario. Data shown in Figure 2 may be linked to other map layers to determine which homes, businesses, roads, or rail lines could be impacted by a storm.

Figure 2: Six Foot Hurricane Storm Surge: Category 4



Flood Modelling. Where the hurricane modelling effort clarifies storm surge and wind patterns, the flood modelling programs provide information on areas that may be flooded by prolonged rainfall over a large geographic area as well as heavy rainfall in a more confined area. Flood models require the height and flow rate of water features in a specific rainfall event, land contours and specific measurements along the banks of water features, and characteristics of a specific storm (Mashriqui et al 1999). Flood models have the capacity to produce outputs that may be linked with geographic information systems to show areas impacted by a rainfall event. Current modelling capabilities from the Natural Systems Engineering Laboratory at LSU allow real time flood modelling for the state using specific rainfall event data provided by the USGS river gauge monitoring system and five foot contour data from USGS DEM products. Where available, more accurate land elevation contours may be used to generate flood inundation zones as illustrated in Figure 3. The flood zones in this figure were created using LIDAR technology (one foot contours) and USGS color Ortho-Photo Quad information.

Figure 3: Flood Modelling Vulnerability Zones
USGS Ortho-Photos



The output from this real time flood modelling effort can also be used in vulnerability assessment. The flood zones established in a rainfall event may be used to identify homes that could be flooded, roads that could be closed, and bridges that could be impacted by an event. Since actual elevation data is required to determine if a specific subdivision, road or bridge would be damaged by a rainfall event, it is not possible to determine the actual consequences of the scenario. FEMA has undertaken the establishment of a national database structure to provide the basis for determining the consequences of floods. The Hazards United States (HAZUS) Program provides a standard database for the assessment of damage to structures in a local community. FEMA is currently creating a flood modelling program to assist state and local jurisdictions in estimating the consequences of specific flooding events. As a part of this effort, local jurisdictions must establish a database with building elevations.

Wildland Fire Assessment Modelling. The US Forest Service has created a comprehensive system for evaluating the potential for wildland fires in the US. The Wildland Fire Assessment System (WFAS-MAPS) includes National Maps of selected fire-weather and fire-danger components of the National Fire Danger Rating System (NFDRS) (Deeming et al 1978; USFS 1999). The computations in this system are based on once-daily, mid-afternoon observations (2 pm LST) from the Fire Weather Network which is comprised of some 1500 weather stations throughout the United States. These observations are reported to the National Weather Service Weather Information Management System (WIMS) where they are processed by NFDRS algorithms. Maps of the US describe the current potential for wildland fires in a 10-km grid. The maps are updated daily year-round for the United States. The approach is based on large scale land and vegetation classifications, real-time weather data, and a comprehensive fuel fire-index; it is intended to complement state or regional efforts to understand wildland fire modelling. Where accurate land use and weather data is available, a more discrete wildland fire model can be created for an area (Burgan et al 1999). Since the effect of wildland fires are more predictable, it is possible to estimate the potential consequences to the built and natural environment.

Information Systems

A critical component of a hazard analysis is the availability of technical information on the nature of the hazard (wind speed, rainfall, storm category, chemical characteristics) and the nature of the area impacted by the hazard (land contours, weather conditions, soil characteristics, tide levels, population characteristics, and building characteristics). On line information systems allow for quick access to current weather conditions, characteristics of chemicals, stream data, soil moisture, or drought levels.

Remote access to information is more widespread including the use of sensors to generate valuable inputs for models and information systems. Federal and local government initiatives are encouraging the installation of direct sensor monitoring systems in areas which are most vulnerable to flooding and chemical spills. On line direct sensors provide current data for information systems (Alter 1996).

Many organizations have been struggling to cope with increasing demands for timely and accurate data to support on-going disaster modelling and decision-making. As a result, large centralized systems have been adapted to more distributed databases. Maintaining linkages and integration of the data is critical especially in times of crisis. In the future, data will include more databases (relational), but also digital libraries and multimedia databases maintained in a distributed environment (Kara-Zaitri 1996). Documentation on the source of data and data types will be critical to ensure that information is used for its intended purpose. The US Geological Survey River Gauge System provides an excellent example of on-line access to current and past river stages and weather data (Wall 1995; Kiester 1997). Documentation on the source of the data and any limitations of its use are provided from the web site.

During the January 1996 East Coast Winter storm a local Washington TV station provided up-to-date weather information to the residents in Washington, Virginia, and Maryland. In a collaborative effort with NASA, Channel 4 WRC created WeatherNet4. Television viewers were encouraged to check out the Web site (http://wxnet4.nbc4.com) for up-to-date area forecasts, current temperatures, and NASA satellite photos that could be accessed from anywhere by computer. Weather stations located at area schools were linked to Channel 4 and this information was also shown on the Web site. During the storm, the Web site had over 70000 hits per day compared to 5000 per day prior to the storm (Crowley 1996). The development of Web-based WeatherNet4 was a unique effort at the time. Today this type of access to information is more available.

Technology needs to be easy to use for anyone in the emergency management process. It should not be viewed as an "expert system" only available to a select few. Ease of use and application to the operations staff must be a critical criteria in the system and application design. Input by a variety of users must be included early in the system design and a broader interdisciplinary team may need to test the system to ensure its successful application. This facilitates a broader understanding of the system and encourages collaboration. Training of staff in the use of the system is fundamental to ensure successful response (National Academy Press 1995).

Dependence on information technology is not absolute; fire-fighters can continue to put out fires without computerized maps, and managers can write reports with pen and paper. Michael (1985) suggests that information clarifies some issues but it obscures and makes others more complex; but continued improvements in the quality, efficiency, accessibility, and dependability of information using technology can enhance our capacity to manage in a crisis and improve the emergency management system (Smith 1996).

Organizational Factors

The basic function of management is to organize not only people, but also the institution itself, including technology, processes, and structure. What are some of the considerations in using the technology in an organizational setting? What should be avoided is the notion that the technology will solve all the organizations problems.

The increasing attention to technology may inadvertently result in information roadblocks. If a communication system is highly centralized, even a limited emergency could result in communication bottlenecks. Sub-networks may need to be created to divert communication from the operations center. A planned, distributed computing capability can be designed by examining elements of the emergency management system. In addition, procedures for managing the system and establishing priorities must be created that do not interfere with ongoing operations of units of the system. Response organizations should participate in exercises that overextend their communication capacity, forcing the system to adjust (Landauer 1995).

In a disaster, complex computing may not be possible for those directly involved in the response. As in other crisis situations, a rear support team can be organized to carry out modelling and analysis. Huh (1999), Robbins (1999), and Vibhas (1999) describe a campus-based rear support team providing remote sensing, weather data, and modelling for hurricane storm surge and wind capability for the Louisiana Office of Emergency Preparedness and coastal states. A critical element of this rear support team is a dedicated fiber-optic link from the state emergency operations center and the campus research labs. Dependable networks must be designed to allow for detailed analysis and linkages established and maintained in a secure environment between support staff and operations units.

In times of crisis, agencies benefit from the assistance provided by other organizations and collaboration with other agencies. The interdependence of organizations must be recognized and nurtured to ensure that collaboration occurs in a disaster. System compatibility, information access, and security procedures will need to be designed to facilitate inter-agency collaboration.

Integrated software provides linkages between different functions such as obtaining data from weather forecasts with modelling capabilities. Model outputs are then formatted for display and use in geographic information systems (GIS). Many organizations evaluate the utility and cost of integrated software in comparison with programs that are designed to address a single function such as weather forecasts, emergency alert, specific database maintenance. Usually the integrated software has a higher cost, but may be balanced with greater program compatibility and utility. As disaster related activities become computer-aided, there is a greater need for linking the programs and access to the information throughout the system. In the end, the integrated software could be more cost effective and offer greater capability in linking to other agencies in the emergency management system.

The technology revolution has resulted in more than just innovations, but also adjustments in social interactions. In many cases, technological developments lead to the notion that there can be a fix for whatever the problems are. Unfortunately the users of technology are looking for the quick-fix, assuming that high technology will address their problem. Some suggest that this is a focus on gadgetry rather than a true understanding of the technology including its strengths and limitations.

CONCLUSIONS

While technology may bring an intelligent assistant to the emergency management community, it is not intended to replace individual discretion. Technology is to serve as a tool for analysis and decisions. Crisis events require extensive information in a limited time; technology may assist in providing access to this information and help in generating alternatives in a short period.

Organizations face a significant barrier in embracing technology and change. Re-engineering occurs when we introduce new technologies and change the system (Hammer et al 1993). The use of new technologies requires organizations to change. It also provides an opportunity to reassess organizational processes including the role and function of technology.

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NOTES

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COORDINATING DISASTER RESPONSES: A STRATEGIC PERSPECTIVE

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A swirling air mass moves off the coast of Africa. Meteorologists at the National Hurricane Center outside of Miami, Florida, begin charting, and local emergency managers along the eastern seaboard begin reviewing staffing schedules for the next two weeks. Unlike their tornado impacted counterparts in the mid-west, they have the benefit of a lengthy forewarning, at least for this potential hurricane. Days, rather than minutes, define the warning and evacuation phases of their community response. Regardless of this or other features of any particular disaster, all local emergency managers confront a common challenge, ie coordination among the complex mix of agencies that will collectively seek to conquer this event.

During the past two decades, emergency managers have moved rapidly towards professionalization (Drabek 1987b).. Through an expanding professional association, the International Association of Emergency Managers, standards are being implemented through a certification process which is impacting hiring and promotion processes (eg see Waugh 2000a; Andrews 2000; Duncan 2000). With encouragement from the Federal Emergency Management Agency (FEMA), institutions of higher education are implementing an array of courses, degree and certificate programs, and curricular materials that will greatly impact this ongoing process. Social science research completed during the past forty years is being discovered and brought into classrooms by a rapidly expanding faculty, some of whom have begun to create specialized texts required by new offerings (eg see Fischer 1998, Waugh 2000b, Oliver-Smith and Hoffman 1999, Mitchell 1999, Charles and Kim 1988, Drabek and Hoetmer 1991). Through its Higher Education Program, FEMA is distributing via the Internet nearly two dozen complete course guides (<http://www.fema.gov/emi/edu/higher.htm>) for college and university instructors . These guides are comprised of lecture notes, suggested student readings and discussion topics, examination questions, multimedia resources, and other pedagogical material.

In the midst of these activities, disasters continue to challenge local officials who happen to be at ground zero. Often of course, they are confronting the familiar - hurricanes, tornadoes, floods, earthquakes, and the like. Occasionally, although with a disturbing increase in frequency, they must seek to guide community healing processes following school shooting massacres or politically motivated bombings. Regardless of the disaster agent, however, the fundamental challenge confronting local emergency managers remains. This challenge was documented through hundreds of empirical studies conducted during the 1950s, 1960s, and 1970s, wherein fragmentation was the defining characteristic of community disaster responses (eg see Barton 1969, Dynes 1970, Drabek 1985, 1986). Community emergency operation centers and computer technologies, especially geographic information systems were among the significant tools local managers implemented as they struggled to reduce the level of fragmentation that continues to undermine the effectiveness of community disaster responses (Drabek 1991; Drabek and Hoetmer 1991).

Coordinating community disaster responses is a complex managerial problem for which there are no simple answers. I will illuminate aspects of this problem through discussion of four interrelated topics: 1) the reality of emergent systems, 2) strategies to enhance coordination, 3) strategies for reducing improvisation, and 4) implications for emergency management theory and practice.

THE REALITY OF EMERGENT SYSTEMS

Numerous case studies have been completed following disasters caused by agents ranging from geophysical events like earthquakes (eg Anderson 1970a) and climatological extremes like hurricanes (eg Moore 1964). These parallel a key observation that was underscored in the first social science oriented disaster study, ie Prince's (1920) analysis of the explosion and fires at the harbor area of Halifax, Nova Scotia, that resulted when a French munitions ship collided with a Norwegian relief ship. *That key observation was that most aspects of the community response were emergent.* This theme has been emphasized by those who have completed literature syntheses (eg Thompson and Hawkes 1962; Barton 1969; Dynes 1970; Drabek 1986).

But what is it that emerges? Analysts have documented two general categories of disaster related emergent phenomena: 1) behavior and 2) expectations (Drabek 1987a). Case studies are filled with examples of each. For example, Anderson (1970b: 420) summarized the rationale used by national guard commanders when they completed tasks following a tornado. Emergent norms were invoked temporarily to suspend the legitimacy of "accepted procedure" although they attempted to make it appear that key decisions were still being made by local authorities. Observations like these have been expanded and integrated into an interpretative framework that has been applied usefully to warning and evacuation responses (eg Drabek 1999, 2000), differential patterns of looting behavior (eg Dynes and Quarantelli 1968, Quarantelli and Dynes 1969), and emergency decision making (Perry and Mushkatel 1984).

In contrast, the "synthetic communities" documented by Thompson and Hawkes (1962), the "emergency social systems" documented by Barton (1969) and the "utopian communities" documented by Taylor et al (1970), all reflect the behavioral aspects of emergence. These sequences of patterned behavior are the social units through which disasters are conquered. Drabek et al (1981) documented numerous multi-organizational networks through which search and rescue tasks were accomplished following such events as the eruption of Mount St Helens (1981), a massive tornado that struck Wichita Falls, Texas (1979), and Hurricane Frederic (1979). Through the use of the social maps that crudely measured these emergent networks, I later emphasized that the effectiveness of local emergency managers depended on their capacity to coordinate the emergent multi-organizational networks (Drabek 1985). Following a similar line of reasoning, Kreps and several associates have produced a complex series of analyses of such emergent systems through data archived at the Disaster Research Center (University of Delaware) (eg Kreps 1989, Kreps and Bosworth 1994). While still in its infancy, increasing numbers of sociologists have emphasized that social network perspectives provide the theoretical breakthroughs required to explore and interpret modern societies and their constituent systems (eg Pescosolido and Rubin 2000 and Portes 2000).

In short, it is these emergent systems that define the essence of any community response to any disaster event; and, therefore, it is these systems that local emergency managers must guide. The degree to which they are coordinated constrains response effectiveness.

STRATEGIES TO ENHANCE COORDINATION

Too often emergency managers, like program directors in other sectors of government, limit their vision by focussing on routine tasks. As this occupation has become more professionalized in recent years, some have emphasized that they must approach their job strategically (eg Senior Executive Policy Center 1984). By this plea, much more is meant than longer range planning or implementation of a so-called "strategic planning process." But to date, only vague recommendations have appeared in the literature. It is clear that critiques of the use of command and control management models derived from military planning approaches have validity (eg Dynes 1994; Neal and Phillips 1995). But these analyses fail to specify a remedy, that is, they do not provide local emergency managers with a clear set of strategies that might form a framework for selective action.

Using the insights of Osborne and Plastrik (1997), I am exploring the relevance of a typology of managerial strategies to a number of disaster events. So far the fit looks good. Let me illustrate examples of progress made to date. Osborne and Plastrik propose five general categories of managerial strategies. Based on post-disaster field work, illustrations of each of these are as follows. Each is a specific strategy that can serve to enhance inter-agency coordination. Each can be an important managerial weapon in any effort to guide the emergence of disaster response systems.

1. Core Strategies. These include managerial actions that reflect efforts to define agency mission. I have identified three specific strategies that local emergency managers have used during some phase of a disaster response: 1) domain clarification, 2) jurisdictional negotiations, and 3) resource familiarization.

Example: *jurisdictional negotiations*. During a flash flood response, a team of fire fighters reported to their headquarters that they had rescued a stranded motorist and her infant. While in process, they were advised that their radio report was being patched directly to the community emergency operations center so others could hear their description of the rescue and the severity of the floodwaters at this location. Everything went fine until they indicated that they had closed the county road to prevent other motorists from potential harm. "We pulled some large trees and other debris into the middle of the road, but someone needs to get lighted barricades out here as soon as possible." The response from the public works director stimulated the local emergency manager to immediately implement this strategy. “No one closes roads in this county but me and my people. Those fire guys are way out of line.”

2. Consequence Strategies. These include a broad range of managerial actions that help others understand and monitor decision consequences. Specific strategies I have identified include: 1) display of decisions, 2) use of information technologies, and 3) maintenance of hospitable EOC social climate.

Example: *use of information technologies*. Following a highly destructive tornado, a local emergency manager kept other department heads and local elected officials updated regarding damage assessments through the production of computer generated maps. As the response progressed, he identified and updated street blockages and, later, security checkpoints on similar maps. In short, the consequences of various decisions and circumstances were displayed effectively using several interrelated information technologies.

3. Customer Strategies. These include a diverse set of managerial actions where various constituent groups are the focus. Within my disaster case studies four very different strategies have been documented that are of this type: 1) communication of citizen expectations and requests, 2) facilitation of media relations, 3) documentation of damage assessments, and 4) documentation of disaster repairs and restorations.

Example: *documentation of disaster repairs and restorations*. A flash flood produced extensive damages in a rural county. Following a Presidential disaster declaration, the local emergency manager, who also functioned as the county administrator appealed to the County Commissioners for additional staff support. A full time staff position was created on a temporary basis to assist in the recovery process. Documentation of disaster repairs and restoration, and in turn the processing of the county application for federal disaster assistance, was thereby facilitated.

4. Control Strategies. The turbulence of disaster response offers unique challenges to emergency managers who confront control issues at every turn as various emergent systems spring forward. My field studies have documented eight strategies that reflect this general category: 1) appeals to prior legitimacy, 2) reference to planning documents, 3) reference to prior experiences (including simulation exercises and actual disasters), 4) decentralization of decision-making, 5) use of self-managed work teams, 6) emergent collaborative planning, 7) emergent community-government partnerships, and 8) implementation of mutual aid agreements.

Example: *emergent collaborative planning*. Following a tornado with a very extensive scope of impact, fire and police officials established a field command post in the parking lot of a large church which bordered the path of destruction. Shortly thereafter, they consulted with the local emergency manager - by circumstance a member of this church - and one of the senior ministers who arrived on-scene. Within minutes, their emergent collaborative planning effort resulted in the relocation of the joint field command post to inside the main church building. Security was established so that other sections of the church complex could be used for temporary shelter of tornado victims, emergency medical treatment and triage, and a temporary morgue. A section of the parking lot was identified as a location for media personnel. Briefings and press releases were coordinated between the city emergency operations center and the field command post.

5. Cultural Strategies. These are the most diverse range of strategies and include at least the following eight types of actions by local emergency managers: 1) enhance awareness of cultural differences among responding agencies, 2) enhance awareness of vulnerable populations, 3) enhance awareness of community diversity, 4) facilitate inter-agency cross-talking, 5) building shared vision, 6) in-house school house, 7) celebrating success, and 8) monitoring stress symptoms among emergency operations center personnel and other responders.

Example: *awareness of cultural differences among responding agencies*. Checkpoints were established at several locations around a security perimeter after a highly destructive tornado with widespread damage. Local law enforcement personnel were assisted by national guard units. The local emergency manager encountered distinctive differences in the use of discretion by local law enforcement officers as opposed to typical responses by national guard personnel. Some homeowners, and even emergency personnel, were denied access to damaged areas by national guard units who explained that they were following orders. As complaints accumulated at the emergency operations center and with local elected officials, the local emergency manager responded by initiating meetings designed to enhance awareness of this cultural difference. Shortly thereafter a new procedure was implemented whereby national guard personnel would consult with the emergency operations center before denying access to persons requesting such at their security checkpoints. The appropriate use of discretion routinely practiced by local law enforcement personnel was continued at the checkpoints they operated.

STRATEGIES FOR REDUCING IMPROVISATION

A large number of prior studies have documented that the twin pillars of emergency management are preparedness and improvisation (eg Kreps 1991). Disasters will always bring some surprises to emergency responders, but the extent and frequency of surprise is reduced to the degree that preparedness is high. Furthermore, the capacity to improvise is greatest when the pre-disaster response network has been nurtured and integrated (Drabek 1987b).

Field studies of effective emergency managers have revealed that more integrated inter-agency networks have been produced when a broad range of strategies have been implemented (Drabek 1990). Implementation of these strategies for coping with environmental uncertainty result in higher levels of inter-agency cooperation and coordination. They also parallel those documented among managers in a wide variety of other types of agencies and businesses (eg Pennings 1981). For example, many successful emergency managers use the strategy of constituency support. That is, they use several specific tactics to identify and maintain the support of other departments and agencies. The four most commonly used tactics are: 1) expanding another agency's resource base, 2) providing emergency management planning expertise, 3) policy influence, and 4) integration of volunteers (Drabek 1990, pg 63). Similarly, many effective emergency managers implement a committee strategy, eg the use of task specific committees empowered to devise solutions to specific community problems and/or a co-optation strategy, eg formally appointed advisory committees that bring together diverse community elements.

Effective local emergency managers also initiate joint ventures, bring in outside experts, facilitate media relationships, and engage in coalition building. Through well-designed organizational intelligence tactics they keep close tabs on community developments so as to effectively use the strategy of agenda control when appropriate (see Drabek 1990 for illustrations of each of these strategies plus discussion of six others, ie innovation, product differentiation, entrepreneurial actions, mergers, regulation, and flow of personnel).

Through the use of these strategies, many local emergency managers have nurtured multi-agency networks that are exercised frequently through a variety of training approaches. Strong levels of trust have been built and so when disaster strikes the response network emerges rapidly and with minimal amounts of improvisation. As surprises are encountered, high levels of trust often are reported as being the key that made the required adaptations or improvisations possible in a timely manner. Thus, while disasters will almost always require certain types of improvisation, preparedness activities that result in integrated multi-agency networks being exercised can reduce the scope required.

IMPLICATIONS FOR EMERGENCY MANAGEMENT THEORY AND PRACTICE

These findings and conclusions clearly underscore the limited applicability of the assumptions and managerial guidance offered by classical bureaucratic theory in various forms ranging from Weber (1947) to Taylor (1947). In sharp contrast to these traditions with an emphasis on standardization, uniformity, and rigid control systems, the profession of emergency management must look elsewhere for more appropriate theoretical paradigms (Dynes 1994, Neal and Phillips 1995). Among the key requirements that past disaster field studies suggest are these.

1. *A strategic perspective is required.* This means much more than long range planning. Rather it implies an approach or orientation to management. Through disciplined implementation of the types of strategies outlined above, the local emergency manager can grasp "the big picture." They can understand, and help those around them understand, how networks of activity fit together into a larger whole. There are alternative strategic paradigms; the two described above are just that, only two. Others, like Crews (1999, pg 24), offer alternatives but still emphasize the importance of a strategic perspective:

> "The third conclusion assumes that emergency management is primarily a strategic activity, and as such, it must analyze the threats to economic and

population centers, determine the significance of the threats, gauge the potential scope of the threats (size and impact), project threat frequency, and provide a course of action (an emergency operations plan) for governing bodies. It must also identify, satisfy, and coordinate requirements that are identified in risk (threat) analysis through application of assets in geographically administered areas by integrating and using academic, business, government, and volunteer resources."

2. *A comprehensive approach is required.* Emergency managers must approach disasters from a strategic perspective that goes far beyond the limited vision of the response phase. While saving lives and property once a hurricane or tornado is approaching must remain a clear priority, this goal can not be met without the implementation of the types of strategies described above that can reduce the amount of improvisation that will be required if preparedness levels are low. Mitigation and recovery planning are also part of this comprehensive approach; but so too are all elements of any community. While the emergency social system that comprises the core of the multi-organizational networks that perform many of the tasks during the response phase are defined rather clearly, eg law enforcement, fire, public works, and so on, other sectors of the community emerge into more central roles during other phases. Hence, comprehensive in this context also refers to inclusiveness. Too often local emergency managers fail to plan for such inclusiveness, especially for the recovery phase of disaster.

3. *Across disaster phases, the composition of the multi-organizational network changes.* Following from the above point, many local emergency managers are surprised at the scope of emergent planning and the richness and diversity of their own community resource base. This is especially true once the immediate demands of the response phase near completion and the network participants shift priorities towards issues of restoration and longer term recovery. Also, as Kuban (1993) discovered through his survey of emergency managers in Canada, there are major shifts in the role priorities, level of informational certainty, and a host of other qualities that such personnel experience. Even among the most seasoned of managers, these shifts are reported as being substantial and at times surprising.

4. *The lower the level of preparedness, the greater the degree of improvisation.* When a strong inter-agency network has been nurtured prior to disaster, the initial response can emerge rapidly with the local emergency manager's facilitation. Through the use of preparedness training exercises, the emergency operations center and the five types of strategies described and illustrated above, the emergent multi-organizational network can be directed toward the disaster generated demand structure. Of course, every disaster has surprises and thus improvisation always must be anticipated; and in cases where the disaster demands present unique and totally unanticipated requirements, even in the most prepared communities, improvisation will be required although it can occur with greater ease.

5. *A strategic perspective on emergency management highlights core functions and approaches, but no single standardized organizational model.* Community histories, like the personalities of department directors and elected officials, and the relatively

decentralized structure of government practiced within the USA all contribute to this observation. Small rural villages confronting disaster will experience emergent multi-agency networks during disaster responses just like officials working within metropolitan areas do. The composition of these networks and the specific *tactics* best adopted to effectively guide the emergent processes will differ considerably. From a strategic perspective, however, the same general types of managerial strategies appear to be implemented by effective local emergency managers. Within those agencies whose culture and organizational structure most resemble the classical bureaucracies documented by Weber, for example most fire and law enforcement units, variants of the increasingly popular Incident Command System (ICS) are useful tools. But communities are comprised of many other types of agencies and organizations that reflect very different cultures and operating styles (eg see Millican 1999). Consequently, local emergency managers, reflecting an awareness and position of inclusiveness, must operate differently. While the ICS framework may be appropriate for important aspects of the *tactical* management of a disaster, emergency managers must operate at the strategic level. This observation is reflected in one of the recent ICS primers. "The Incident Command Operation is responsible for on-scene response activities, and the EOC is responsible for the entire community-wide response to the event." (EMI 1998, pg I-15). In short, organizational models, individual personalities, community histories, and the task demands of any given disaster vary considerably, but there are common types of broad strategies that when implemented may reduce the degree of improvisation and increase both the effectiveness and efficiency of the response.

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NOTES

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STUDENT PERCEPTIONS OF HAZARDS AT FOUR SCHOOLS NEAR MOUNT RAINIER, WASHINGTON, USA

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INTRODUCTION

Mount Rainier is a 14,410 ft. active volcano in Washington, which poses a risk to residents of the increasingly developed valleys around its base. Lahars (volcanic mudflows) are the greatest volcanic hazard in these valleys, with approximately 150,000 people at risk. These fast-flowing slurries of mud, boulders, and water originate from eruption-produced melt water and occasionally from the collapse of weakened portions of the mountain. Lahars capable of reaching population centers have a recurrence interval of 100 to 500 years. Stumps excavated by builders and brought to the current land surface are a common sight in the Puyallup River valley and a constant reminder of the Electron Mudflow (lahar) that buried them 500 years ago. This, the most recent major lahar, filled the valley, wall to wall, to a thickness of around twenty feet, burying and killing the trees. Future lahars will bring long-term disturbance of river systems, with subsequent flooding of sediment-clogged streams.

The US Geological Survey (USGS) has mapped lahar hazard zones (Scott and Vallance 1995 and Hoblitt et al 1998) in this area and is now undertaking an effort to inform emergency managers in order to assist them in developing appropriate reduction, readiness, and response measures. As part of this effort, the USGS, with the Pierce County Department of Emergency Management, have installed a series of Acoustic Flow Monitors (AFMs) to provide effective warning of lahars in the Puyallup and Carbon River valleys. Emergency managers have produced an "Emergency Response Plan", which includes an evacuation plan, a blueprint for co-ordination during crises, and a plan for promoting long-term public awareness of these hazards and their consequences.

Currently the USGS, local educators, and emergency managers are engaged in a public education program with the intention of informing residents and visitors about volcano

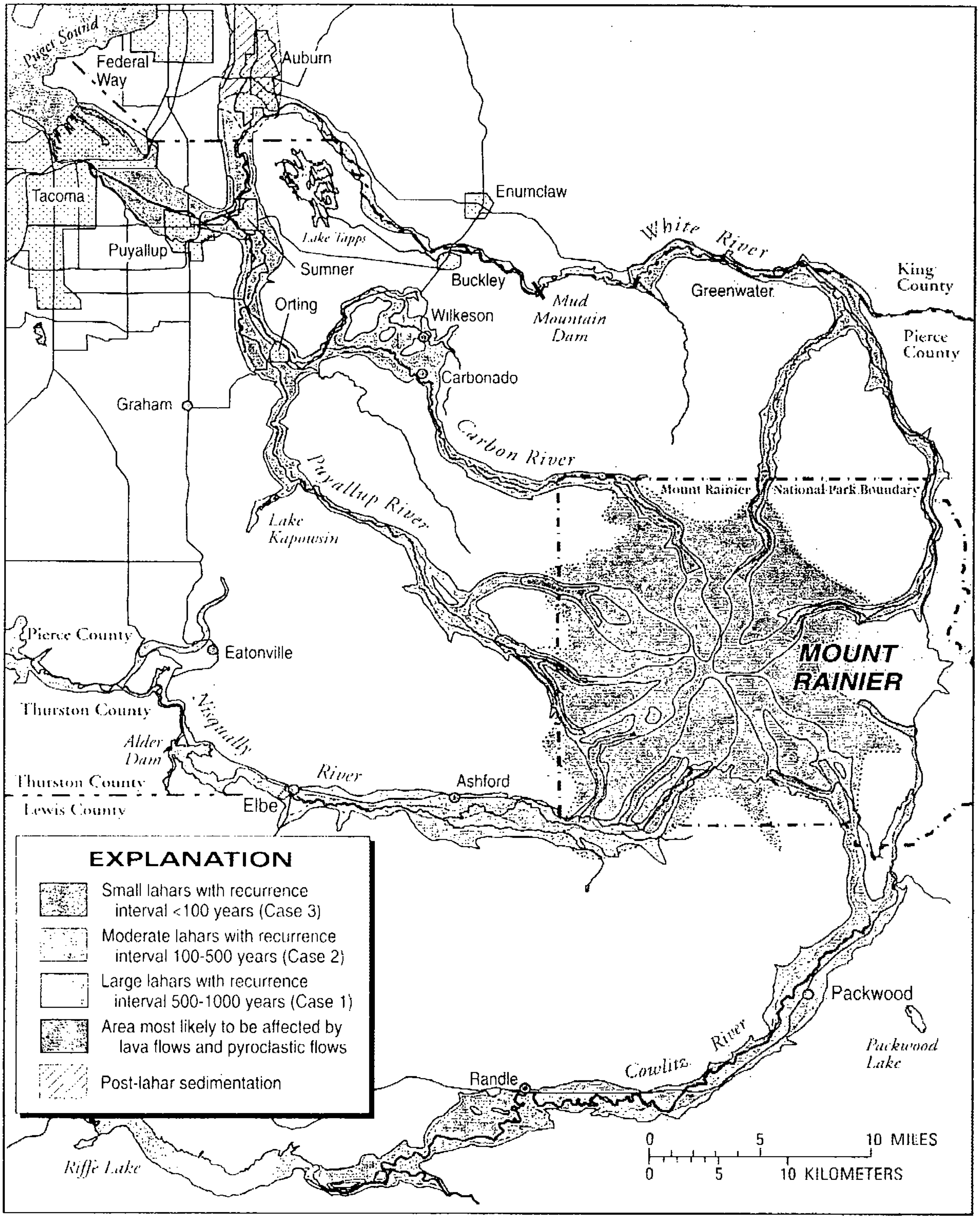

Figure 1: Hazard Zones Around Mount Rainier

hazards, evacuation routes, and other appropriate response measures. Local school educators and their students can play a crucial role in disseminating information about natural processes, hazards, and recommended preparedness measures. Educators have incorporated geological and hazard issues into their classrooms to varying extents. The challenge is to determine the current understanding of the hazards, the most effective means of relaying the information about them, how to prepare to reduce the adverse consequences associated with hazard activity, and keeping alive the message of the mountain's potential over the long-term. For this we require quantitative information.

THE ASSESSMENT

During Spring 2000, the authors assessed student's perceptions and knowledge about natural hazards in the southern Puget Sound lowland. This study involved collaboration between the Institute of Geological and Nuclear Sciences in New Zealand, the US Geological Survey, Pierce County Department of Emergency Management, teachers and safety officers at four schools in the Emunclaw, Puyallup, Sumner and Orting School Districts, and 327 school students (Figure 1).

Four schools (Orting High School, Sumner High School, Enumclaw Middle School, and Rogers High School) agreed to participate in the survey. Orting High School and Sumner High School are located in high-risk zones, and Enumclaw Middle School and Rogers High School are in low risk zones (Figure 2).

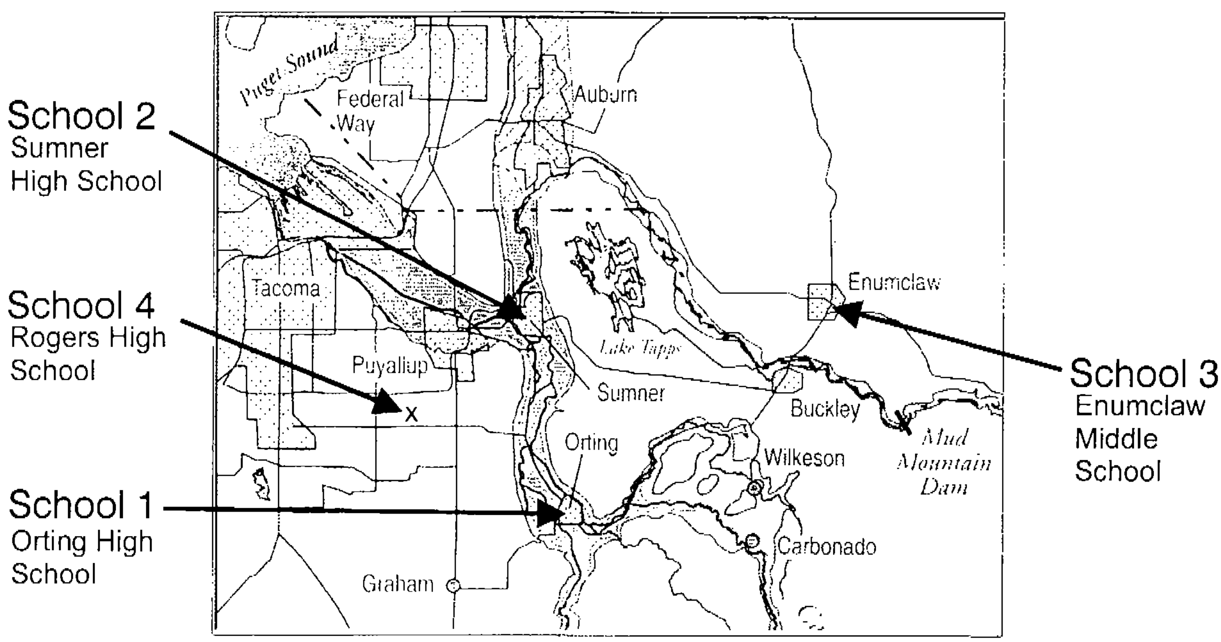

Figure 2: Location of the Four Schools Surveyed

Over the past few years students and educators have been exposed, in varying degree, to issues relating to volcanic risk and the preparations and actions recommended to reduce this risk. This has involved, for example, participation in teacher workshops; use of an educational poster and activity guide (Driedger et al 1998a) produced by the USGS, National Park Service, and Orting School District; a prepared presentation (Driedger et al. 1998b); and several class presentations, requested by teachers involved in the assessment but not with the same students (Enumclaw and Orting Schools). The above products have been distributed unequally, with no attempt having been made to ensure their comprehensive distribution.

Because of its location at the confluence of two valleys where lahars may travel, Orting is the community most at risk. Other communities are at risk, but have a longer period for evacuation and a lesser (or no) chance of inundation. Volcanic risk to the community of Orting has received significant media coverage, and has resulted in the appearance on TV and radio and in newspapers and magazines of students, teachers, and other community leaders, nationally and internationally. The other communities assessed in this study have received only a fraction of the coverage provided for Orting. Beyond reference on maps, there has been minimal or no mention of community names beyond Orting.

Previous Studies Assessing Similar Groups

This work builds on studies undertaken over the past five years in New Zealand to assess students' and community members' understanding of hazard issues and the factors

identified as contributing to community vulnerability to adverse hazard consequences (Johnston and Houghton 1995; Ronan and Johnston 1997; Johnston and Benton 1998; Ronan et al 1998; Johnston et al 1999; Paton, Millar, and Johnston, in press; Paton, Smith, and Johnston, 2000).

Survey Instrument

The questionnaire, based on one developed for an Auckland (New Zealand) study (Ronan and Johnston 1997), was designed to assess students' level of awareness, risk perceptions, factual knowledge, physical preparedness, and psychological issues related to hazards and mass emergencies (ie floods, storms with high winds, fires, earthquakes, volcanic eruptions, tsunamis, chemical spills/gas leaks, tornadoes). It also assessed students' prior exposure to (a) specific hazards and (b) educational programs designed to increase awareness, knowledge, and preparedness that were provided either by Emergency Management or by school staff (primarily teachers).

Results

The questionnaire and a complete record of results can be found in Johnston et al (2001). In this section we review key results. Students in all schools had good awareness of the hazards which might affect them in their community. At Rogers and Enumclaw schools earthquakes, fire, and storms were perceived to be the three most likely hazards to affect them in the future. At Sumner, earthquakes and fire were the two highest ranked hazards with storms and lahars ranking third equally. At Orting, however, lahars, floods, and earthquakes were the three top ranked hazards.

When asked to define the hazardous event most likely to affect their community in the future, the majority of all students thought that storms (87%), earthquakes (72%), and floods (54%) were likely to occur sometime within the next 10 years. A high percentage of students believed that several hazards (earthquakes 98%, storms 96%, floods 84%, fire 84%, volcanic ash 84%, landslides 84%, and lahars 74%) were likely to affect their communities within their lifetime. In Orting, where there has been intense public education and media attention regarding lahars from Mount Rainier, 57% of students cited lahars and floods as the hazards most likely to affect their community. In Sumner, a town some 20 km (12 miles) distant and also at risk, but which has been virtually spared all media attention, only 12% listed lahars as one of two principal hazards. This finding indicates the need for additional and balanced educational work in some schools and communities, especially in Sumner.

All schools have hazard awareness programs and not surprisingly the majority of students reported having been involved in these programs (Figure 3). Students were encouraged to talk with their parents about hazards as part of these programs; however not all reported this when asked. Of those who went home and discussed how to prepare for an emergency (from all schools), a significant majority (82%) reported parental willingness to discuss the issue with them. More work is required to determine the content of these discussions, however, and their implications for hazard understanding and preparedness over time.

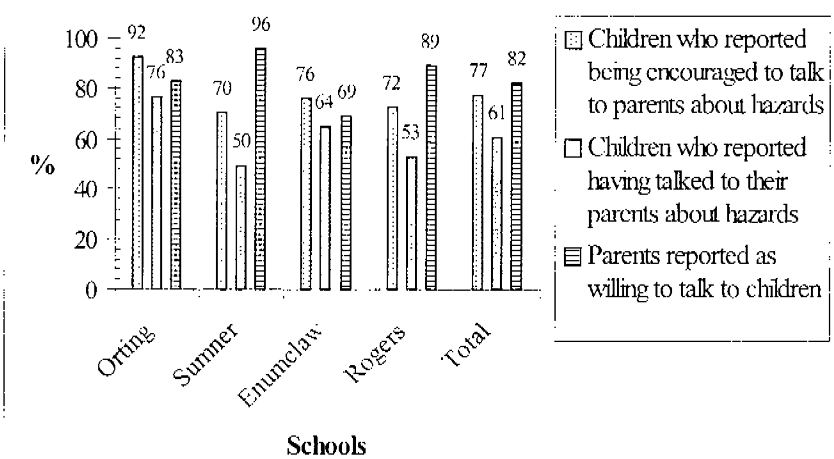

Figure 3: Child /Parent Reported Interaction

Talking about natural hazards is sometimes credited with alarming students, though when asked whether any of these hazards scared or upset them, 60% replied "not at all"; 39% were scared "sometimes"; less than 2% were scared "often". These data suggest that it would be prudent to conduct more systematic assessments of the relationship between the concerns and anxieties regarding natural hazards and their implications for students' attention to preparedness information. A similar problem has arisen for earthquake hazard anxiety in New Zealand (Paton et al 2001). It also suggests a need to move away from intervention designed primarily to increase awareness and to re-frame the way in which hazard information is presented. Awareness based activities, broad-based public

Table 1: Levels of Reported Household Preparedness

	Orting % (n=76)	Sumner % (n=93)	Enumclaw % (n=90)	Rogers % (n=68)	Total % (n=327)
Have a flashlight	92.1	89.2	96.7	97.1	93.6
Protect breakable household items	21.1	28.0	20.0	29.4	24.5
Put strong latches on cabinet doors	17.1	18.3	16.7	25.0	19.0
Store hazardous materials safely	44.7	47.3	44.4	58.8	48.3
Add lips to shelves to keep things from sliding off	10.5	16.1	11.1	14.7	13.1
Strap water heater	34.2	40.9	34.4	30.9	35.5
Install flexible tubing to gas appliances	18.4	22.6	22.2	14.7	19.9
Bolt house to foundation	31.6	34.4	38.9	23.5	32.7
Stockpile water and food for three days	48.7	46.2	43.3	54.4	47.7
Have a portable radio and spare batteries	72.4	69.9	72.2	80.9	73.4
Have a fire extinguisher	76.3	79.6	83.3	82.4	80.4
Have a smoke detector	97.4	88.2	97.8	100.0	95.4
Have a first aid kit	81.6	86.0	93.3	92.6	88.4
Store wrench near gas turn-off valve	26.3	33.3	13.3	23.5	24.2
Pick an emergency contact person outside of the Northwest	31.6	46.2	34.4	36.8	37.6
Someone in family has learned how to put out fires	53.9	60.2	67.8	66.2	62.1
Buy additional insurance (eg home)	63.2	59.1	62.2	66.2	62.4
Someone in family has learned to provide first aid	65.8	77.4	74.4	83.8	75.2
Find out if you are in an area particularly vulnerable to a natural or other kind of hazard	52.6	44.1	37.8	51.5	45.9
Have home inspected for preparedness	11.8	18.3	12.2	16.2	14.7

policy campaigns describing hazards and their effects, are more likely to raise anxieties and reduce acceptance of the message, thus curtailing the formation of action plans (Paton and Johnston in press).

New approaches are required (Paton and Johnston in press). Presently, preparedness information tends to be framed in terms of activities designed to safeguard the person from negative or adverse hazard effects (which could influence the anxieties evident in the above responses). While considerable work still needs to be done to design such messages, and to assess the effectiveness of different message characteristics (Paton 2000), alternative approaches could focus on framing messages in ways that reflect the positive values associated with living in particular geographical locations and the precautions necessary to ensure that students can continue to engage in the activities they enjoy (eg photographic examples from the town of Yakima show students, appropriately protected by dust masks, riding their bikes around the ash covered streets following the Mt St Helens eruption in 1980). By demonstrating how hazard consequences can be actively managed, and actively conveying the message that, as a consequence, hazard activity can be rendered inconvenient rather than catastrophic, anxiety may be lessened and preparedness messages both attended to, practiced, and sustained over time.

While the vast majority of students (93%) reported having practiced emergency preparation at school, far fewer reported having done this at home (some 32%). Reports of household preparations varied (Table 1). Reported levels of preparedness for the Y2K problem was also surprising low, with 72% of all students reporting their family's undertaking little or no preparation prior to New Year 2000.

The final set of questions explored students' understanding of specific volcanic hazard issues. Almost all students (97%) were aware of the threat in Washington, however the majority believed incorrectly that Mount Rainier was the volcano most likely to erupt in Washington. The intensity and recent timing of Mount Rainier media outreach efforts may be reflected in the majority of students erroneously choosing Mount Rainier as the volcano most likely to erupt (90%) over Mount St. Helens (7%). The USGS considers that Mount St Helens has erupted more frequently than Mount Rainier during the past 4000 years and is thus more likely to erupt next (Wolfe and Pierson 1995, Hoblitt et al 1998). There was generally good awareness of the correct procedures to respond to a volcanic threat by students at all schools.

DISCUSSION

It has been demonstrated that school education programs play a valuable role in raising the awareness and understanding of students and community members of the range of natural hazards they face (Alexander 1992, Ronan and Johnston 1997, Johnston and for a range of hazardous events. Their study identifies a number of specific factors which can enhance the effectiveness of such programs. These include: 1) the integration of school programs with wider community emergency management initiatives, 2) programs Ronan 1999). Ronan and Johnston (in press) provide empirical support for the value of school programs in helping families and community members becoming better prepared that increase knowledge of hazards and what to do before and during events, and 3) programs with an interactive component in which students are encouraged to share what they have learned at school with their parents or guardians. This, and other studies (Paton et al 2000), emphasize the benefits associated with specifically tailoring preparedness messages and strategies to the needs and expectations of students and communities and presenting information and recommendations in ways that focus on positive and growth outcomes, rather than on trying to encourage people to undertake activities to minimize the adverse consequences stemming from rarely occurring events (Paton and Johnston in press, Paton et al in press). A focus on development and growth may also help sustain these benefits over time, an important issue when dealing with infrequent hazard activity. At the same time, it is important to acknowledge that the effectiveness of these initiatives will not be truly known until assessment of actual responses to hazard effects is undertaken (Glantz and Johnson 1999, Paton et al in press).

Natural disasters, by their nature are rare, therefore, in most cases children seldom have the opportunity to gain personal experience of major events. The mass media provides a large amount of disaster news annually. Disasters that do occur, both locally and (or) in outside locations, provide an ideal opportunity for children to get an understanding of the event. Media reporting, however, often contributes to the biased perceptions that exist. The media frequently gives uneven coverage focusing on high impact-low frequency events (Wrathall 1992). There is commonly a bias towards reporting which describes those affected as victims and focusing on the losses they experienced, rather than describing them as survivors or describing the experiences of those only marginally affected by hazard activity (Lopes 1992); nor does this coverage tend to focus on the positive outcomes that community members often report following exposure to hazard activity (eg increased sense of community, discovering unknown personal strengths, increased economic activity). This frequent lack of valuable follow-up reporting thus fails to show the successful coping of most disaster-impacted communities and the resilience factors that contributed to this outcome, which can be encouraged though readiness programs (Paton et al 2000). The systematic assessment of resilience and growth processes can provide valuable information that can be used as a foundation for discussions of preparedness and provide positive strategies and targets for communities (Paton 2000). As a vehicle for promoting and sustaining such initiatives, schools can play a vital role in both educating children about what has happened and in helping with the coping process (Anderson 1987, Johnston and Ronan 1999, Ronan and Johnston in press).

In summary, data from this assessment provides a baseline to evaluate the effectiveness of future hazard education programs. If derived from theoretically rigorous measurement models, survey data can be used by emergency management professionals to assess community needs, develop readiness and response strategies, and plan the allocation and use of resources for future events. To extend the baseline, a wider community assessment would be useful to measure understanding, attitudes and levels of preparedness of other groups in the community.

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NOTES

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CREATING A BALANCED RESPONSE: AN APPLICATION OF DATA MINING TO DETERMINE WHEN TO SHELTER OR EVACUATE

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INTRODUCTION

Technological hazards are a fact of modern life. Chemicals and elements that, when properly harnessed, are of enormous benefit to humans, can also be among the deadliest agents when control over them is lost. In these circumstances, emergency managers must attempt to ensure that the public is safe during the response and recovery phases of an accident. Emergency planners can greatly aid in this process. Well-designed plans, carried out in a well-rehearsed manner, can be the difference between public well-being and grievous injury.

Following the release of a toxic compound into an inhabited environment, emergency response personnel can employ three strategies. The first is to shelter the population that is downwind of the hazard in-place; the second is to evacuate the potentially affected public (Glickman and Ujihara 1990, Rogers et al 1990). The third option is to employ a combination of shelter-in-place and evacuation. That is, a balanced response can be used to protect the public.

This paper briefly describes how a guidebook for such a balanced response was created for use in an area surrounding a US Army chemical weapons storage depot (IEM, 2000). This was accomplished through the use of a suite of modeling and simulation tools, including a technique that is employed in the growing area of data mining.

Data mining techniques were developed in order to help decision-makers optimize choices based on the analysis of very large data sets (Foss 1997). In the project described here, a data mining tool was used to characterize a very large set of chemical weapons hazards in a manner that will allow emergency managers, planners, and responders to formulate a set of optimal protective actions for several emergency planning zones downwind of a chemical agent release.

BACKGROUND

The Chemical Stockpile Emergency Preparedness Program (CSEPP) is jointly administered by the Federal Emergency Management Agency and the Department of the Army. It was created in order to ensure that the public receives maximum protection (FEMA 1991) in the case of an accidental release of chemical weapons as they are being destroyed, as called for under the provisions of the Chemical Weapons Convention treaty.

One of the CSEPP sites is the area surrounding the Anniston Army Depot in Alabama which stores 2254 tons of weapons containing chemical agents, including mustard and the nerve agents VX and GB, also known as Sarin (ANCDF 1998). Planners and policy makers in the Anniston area have designated 104 emergency planning zones around the depot with a population of approximately 350,000. These zones form the basis for planning and response in the event of an accidental release of agent while the chemical weapons are being stored or destroyed.

PROBLEM

In order to maximize public protection following the release of a chemical agent, emergency management officials sought to tailor protective action decision-making to the characteristics of the release, the meteorological conditions, and the population and infrastructure characteristics of the Anniston area. In accomplishing this, a large number of factors were to be considered. An additional requirement was that the decision support tool be created in hardcopy form so that emergency management staff would not be reliant upon automation, which might be unavailable in the event of a loss of electricity which might occur at the same time with the accidental release of the chemical agent (eg in the event of an earthquake).

APPROACH

Many factors interact to influence the optimal protective action in response to a toxic vapor release. Three main groups of factors include the hazard characteristics, the population and infrastructure characteristics, and behavioral characteristics. Some of the ways in which these factors causally interact are shown in Figure 1.

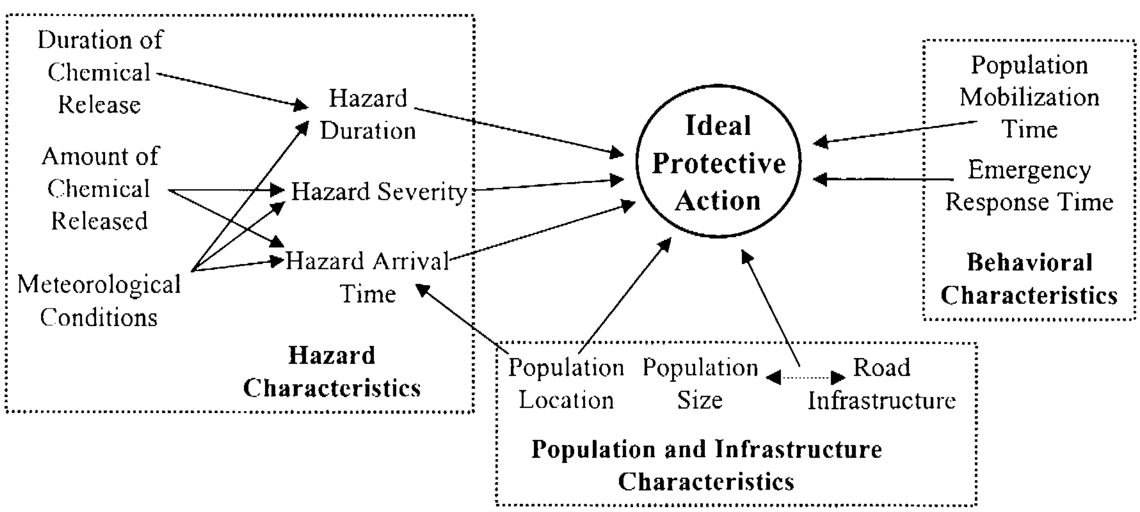

Figure 1

For example, the time at which a hazard arrives at a given population center depends on the amount of chemical that is released into the environment; meteorological conditions such as wind speed and direction, season, and atmospheric turbulence; and the location of the population center relative to the site of the release.

In the case of a short duration, quickly moving release, it will be desirable to shelter the downwind population in place, as an evacuation cannot be mobilized in time for the population to avoid the effects of the release. On the other hand, if the release is of long duration and moves slowly over the downwind area, evacuation is the best strategy, as long as the population can be removed from the downwind area prior to receiving a dosage of agent that impairs their ability to complete the evacuation. This will be influenced by the size of the evacuating population relative to the capacity of the road network.

The speed of the emergency response can also affect the decision to shelter or evacuate a given downwind area. A slowly moving, short duration release may require that affected zones be sheltered if there is no time to mount a successful evacuation due to an delay in emergency response.

Finally, there are cases in which no single, simple protective action strategy minimizes exposure to the downwind population. For example, populations located close to the source may have sufficient time to evacuate if the road network is relatively clear, but not if the network is congested. In such a case, if the populations located further downwind of the release location can be temporarily sheltered successfully, the strategy that minimizes exposure to the downwind population as a whole may be to shelter some of the outer zones temporarily and to evacuate the inner zones.

The number of important factors that determine the best protective action strategy makes planning and decision-making during a response impossible to carry out on the basis of 'back of the envelope' calculations. What is needed, particularly during an emergency response, is a method of determining the protective action quickly. One approach is to employ a rough rule of thumb or default protective action. As discussed above, however, a pure strategy of shelter-in-place or evacuation may not provide minimal exposure to the downwind population.

SOLUTION

One way this problem can be addressed is through comprehensive analysis and planning. By combining research on emergency management processes, evacuation time estimates, toxic vapor dispersion and infiltration into structures, and population distribution, computer models can be constructed which reveal combinations of sheltering and evacuation that minimize risk under a wide range of hazard profiles.

Previous modeling revealed that an evacuation rule of thumb was particularly problematic for the Anniston community. The Alabama CSEPP Guidebook was therefore designed around a concept of sheltering populations that could be protected with that protective action strategy in order to ensure that evacuating populations could remove themselves from the downwind hazard area prior to receiving adverse consequences.

A high level diagram of this decision logic concept is shown in Figure 2.

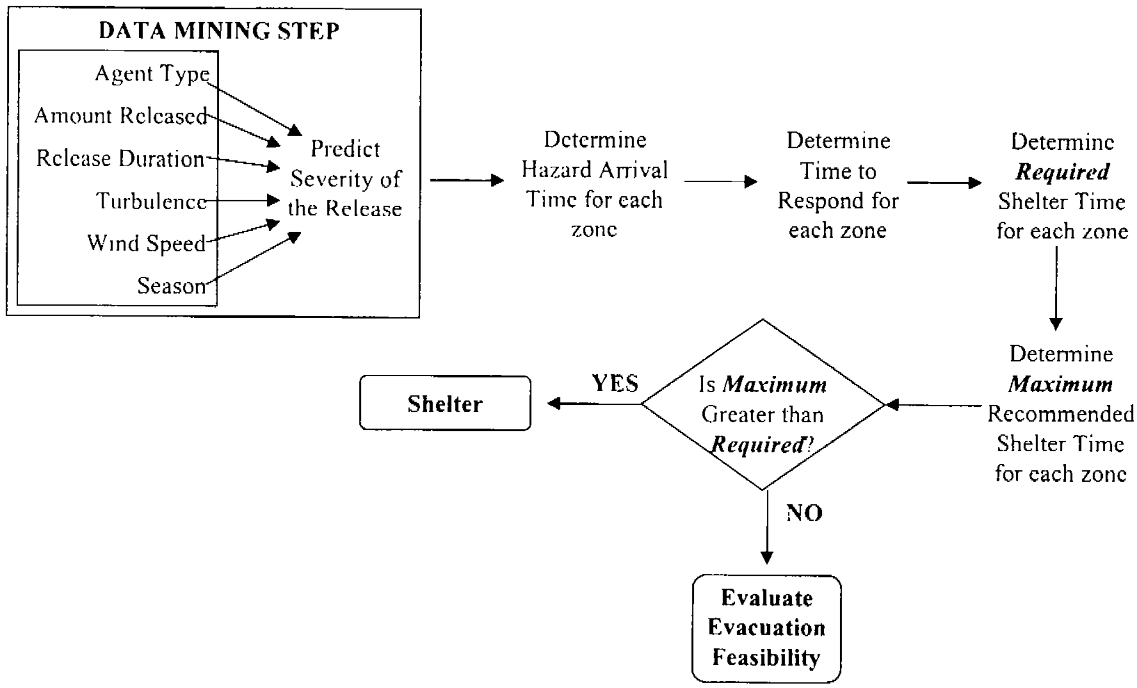

Figure 2

Note: See Wilson et al 2000 for a detailed description of this process.

The first step in creating a protective action decision for a given zone downwind of the hazard is to predict the severity of the hazard from the perspective of a downwind population that shelters. This prediction is made with a set of decision rules that were derived using a data mining technique, a topic that will be discussed below. The user then determines the hazard arrival time for each zone. This would be done using a gas dispersion model such as D2PC (IEM, 1993).

Next, the user calculates the time to respond for each zone. This is based on the time that has elapsed since the onset of the accident and the hazard arrival time. Following this, the required shelter time is calculated. This is based on the calculated duration of the hazard once it reaches the zone. The results of the first step are then combined with information on the timeliness of the emergency management response to determine a maximum recommended shelter time. If this time is greater than then required time, the zone is sheltered. If it is not, the final step is to use a lookup table to determine whether evacuation is feasible for the zone.

Data and Modelling

In order to produce this decision support tool, a number of data sources and modelling techniques were employed. The goal of the analysis was to roll up the results of millions of simulations involving the hazards into a set of lookup tables and decision trees that can be used, in combination with some simple arithmetic calculations, to make a balanced protective action decision. The following is an abbreviated discussion of some of the models that were used and the data they incorporated.

For the first step of the decision logic, a means of predicting the amount of time that a sheltered public could remain in their structures and avoid fatalities was created using information about some of the most important factors that determine the characteristics of a chemical agent plume. These include the type of chemical agent, the amount released, and the duration of the release. This information would be available to the emergency response community from the Army depot in the case of a CSEPP emergency and is available through the use of a maximal credible event, which is a chemical agent source term that has been prepared by the Army in advance of an emergency.

Comprehensive quantitative risk assessment (QRA) studies of potential release sources have been published for each of the CSEPP sites. The QRA for the Anniston site (SAIC 1997) was used to determine the range of release amounts and times for each type of chemical agent stored at the site. An accident set was then created which included a total of 1728 different possible source terms. These were then combined with 172 different meteorological combinations, each consisting of a wind speed, Pasquill stability class (a measure of atmospheric turbulence), and season (which affects the height of the mixing layer in the atmosphere).

Each source term and meteorological combination was then modeled with a D2PC-compliant gas dispersion model, and the time to exceed a No Deaths dosage of agent was computed for a structure with an air change rate of 1.94 air changes per hour 3 km from the source. This distance corresponds to the populated area nearest the location where the weapons are stored. The value for the air change rate was chosen based on previous work (Karl et al 1999, Murray and Burmaster 1995) that indicated that 9 out of 10 structures in the Anniston area have lower air exchange rates. Thus, this is a fairly conservative estimate of the actual air exchange rate of structures in the area.

The resulting data set of predictor variables and sheltered hazard arrival times was then mined and a set of decision trees was created.

Data Mining

Data mining methodologies have become quite popular in recent years as computing speed and storage capabilities have increased. There are a number of classification and prediction algorithms that fall under the rubric of data mining. These include neural networks, clustering programs, association rules, and classification and regression trees (Aggarwal and Yu 1999). The typical reason for application of a data mining technique is knowledge discovery within a large database. This usually involves the prediction of some criterion variable value from a number of predictor variable values.

Data mining has successfully been employed in a wide variety of applications, including market segmentation models, credit risk analysis, and medical diagnosis. The classification and regression tree (CART) approach used in this project was developed within the context of medical decision-making (Breiman et al 1984) in order to provide medical practitioners with an easily used method of predicting the outcomes of various treatment options.

Perhaps the most common forms of statistical prediction involve calculating a regression equation, which is then used to predict an outcome of interest. One problem with this approach is that making a prediction involves computing a series of multiplications and additions, which can become time-consuming and prone to error if they must be done without the aid of a computer. This makes the regression approach difficult to employ in a hardcopy format, particularly under the stressful conditions present during an emergency response. The CART approach, in contrast, produces a decision tree that can form the basis of simple if-then rules that can be used to predict an outcome of interest. For the Guidebook project, the variables shown in the box in Figure 2 formed the basis of the CART analysis, which was carried out using a commercially available statistical package (Mathsoft 1999). The resulting decision rules allow emergency managers and planners to predict the amount of time that persons could stay sheltered and avoid fatality on the basis of information available from the Army depot emergency operations center very shortly after the start of an accident.

A notional example of a decision tree produced by the CART process is shown in Figure 3.

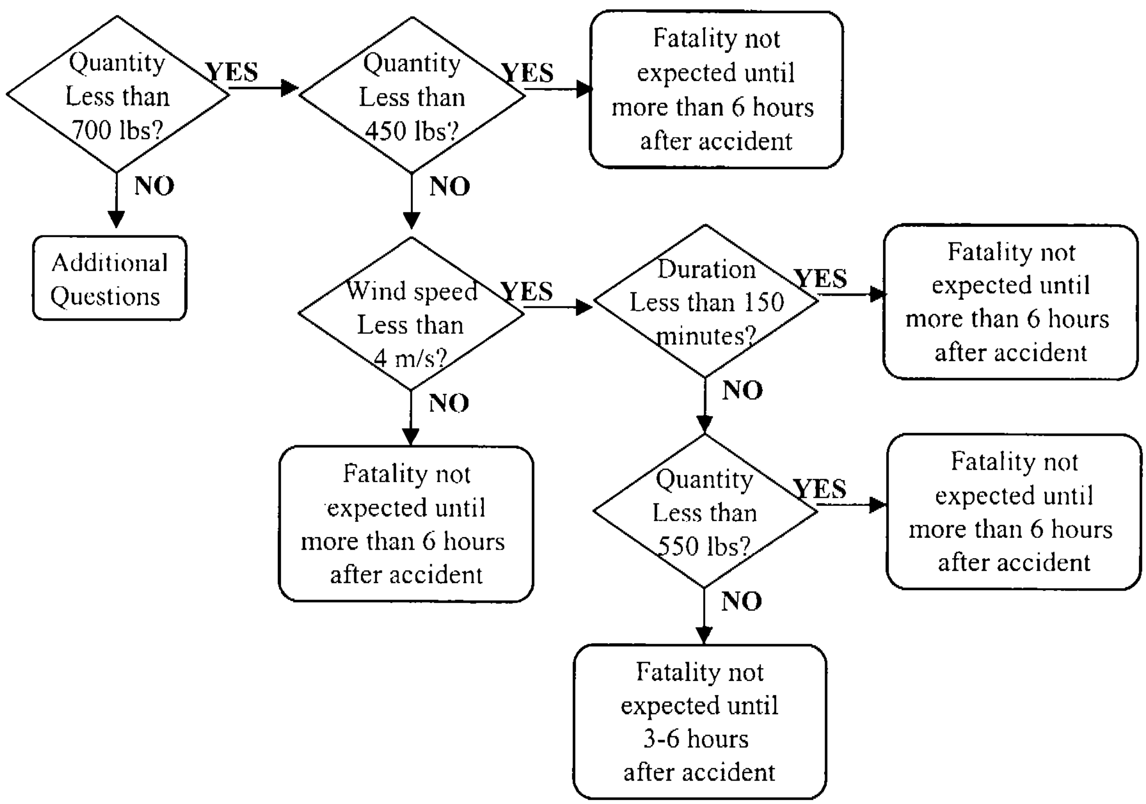

Figure 3

For ease of use, these diagrams were converted into a series of tables. Each entry in the tables is a question. The user then moves through the tables, answering the questions until a prediction is reached regarding the expected outcome if the downwind population shelters.

DISCUSSION

Making the correct protective action decision in response to a release of hazardous materials involves accounting for a large number of important factors. The number of interactions among these factors can quickly lead to millions of plausible accident scenarios. Planning based on such an astronomical number of possible scenarios is prohibitive. However, if these factors and their interactions are not taken into account in some manner, the emergency manager runs the risk of making a decision that is less than optimal. Some middle ground between simple, sub-optimal rules of thumb and paralysis by analysis must be found in order to make the best decisions possible under stressful conditions. The project described in this paper was conducted with the goal of finding that middle ground.

The approach taken was to use a set of models to simulate toxic vapor dispersion and infiltration into shelters, emergency response system behavior, evacuation network characteristics and traffic flow, and population distribution and mobilization in response to a chemical event. These models produced quantities of data that are not directly useable by emergency planners and managers; therefore, a decision structure was created that would allow decision-makers to take advantage of the simulation results.

The decision structure underlying the Guidebook consists of lookup tables and some simple calculations - nothing more difficult than the subtraction of 3-digit numbers and the comparison of pairs of numbers. Training in the use of the Guidebook showed that, after a 30-minute training session, planners were able to work through it and arrive at a correct answer in less than 5 minutes. In the future, this structure will be able to provide shelter-in-place and evacuation decisions for the Alabama CSEPP emergency planning zones even more rapidly. Work is currently being undertaken to create an automated version of this methodology to complement and extend the capabilities of the paperback version of the Guidebook.

There are many other aspects of the Guidebook project that were not within the scope of this paper, which focused on the application of a data mining methodology to one aspect of the overall problem. The CART methodology yielded a set of decision trees that can be used without any requirement for calculating additional numbers in order to make a prediction regarding the time that downwind populations can shelter before receiving a lethal dose of chemical agent. The prediction is made using six pieces of information that are available to emergency personnel within minutes of an accident and include some of the most important determinants of a plume's behavior. This prediction is then used as a basis for deciding if it is possible to shelter the downwind area, thus clearing the road network for other populations that may not be able to shelter in-place and avoid lethality.

Although the Guidebook was developed specifically for the Alabama CSEPP community, the process used to create it is general in nature. It could be used for almost any kind of acute toxic hazard. It requires an adequate plume model for the type of chemical release, information regarding the traffic network around the source of the release, and the possible meteorological conditions for the area. In addition, information regarding the distribution of the surrounding population and characteristics of warning and response systems is required.

It may appear that such data requirements would prohibit the development of such a system for many jurisdictions. However, much of the required data can be obtained cost-effectively through public sources and through focussed tabletop exercises - and the benefits of a balanced response can be very great. A calculation of the risk reduction due to employing the balanced response in the Anniston area showed that the reduction was most commonly 75% with respect to shelter-in-place for the emergency planning zones (Lemcke et al 2000).

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ISSUES IN THE PROFESSION: THE EVOLVING ROLE OF THE EMERGENCY MANAGER

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INTRODUCTION

Current research into emergency management identifies a number of issues in the profession, such as the functional position of the field in the government administration, the lack of agreement regarding a core skill and knowledge set that can be uniformly applied to the field, and the issues of education, certification, and accreditation in the field of emergency management. Circumstances such as the increasing settlement of hazard-prone regions, higher expectations on the part of elected official and community residents (usually without the addition of resources), and the increasing knowledge required by emergency managers have engendered ongoing debate as to how to resolve these issues. The debate has included much discussion regarding the needs of the emergency manager with respect to education, certification, and program accreditation and the standards that ought to be applied regarding knowledge and practice of emergency management. This paper briefly examines some issues in professionalization and offers some alternative approaches.

OVERVIEW OF RELATED RESEARCH

The academic research that specifically addresses the professionalization of emergency managers is a relatively small body of work. More is being published on the practitioner side, as the issues are debated in conferences, meetings, and organizational bulletins (ie the IAEM Bulletin for May 2001, *Special Focus Issue: Emergency Management Education*) which address many of the current issues facing the field. Recent research-based literature does, however, tell us about the direction and suggested approaches to the broader emergency management issues.

Neal and Phillips (1995) deal with the dissonance between a "command and control" tradition in the practice of emergency management, and the ad hoc, or emergent behavior and self-organization that tends to take place after a disaster. E L Quarantelli (1988a, 1988b) notes that the command and control model works under a basic premise that has not been supported by empirical research. The premise that disasters cause the disintegration of social structure, and more specifically the disintegration of pre-disaster authority structures, is often used to justify the formation of centralized control and decision-making. In fact, authority structures usually remain intact and organizations operate on a par with their normal effectiveness. Therefore, he concludes, it is impossible to establish a centralized structure that supplants existing authority structures in the immediate post-disaster period.

The research by these individuals indicates that emergency managers need to be flexible, responsive to emerging organization, and prepared to abandon the "cut in stone" Standard Operating Procedures (SOPs). SOPs are the customary means by which most response personnel are trained, but rarely does the post-disaster scenario resemble the SOP that is supposed to respond to the situation.

Quarantelli (1988b) also examines the value of planning as a process, rather than focussing on the product - the plan. When asked about the success in preparing for the Normandy invasion in World War II, Eisenhower replied, "Plans are nothing. Planning is everything." Too often agencies are focussed on the production of a disaster plan, rather than benefiting from a planning process that encourages interaction and flexible response based on the needs of the community at that given moment. Quarantelli (1988b) points out several activities that are more process-oriented, such as information sharing meetings, conducting drills and exercises, conducting training sessions, and networking among others.

Thomas Drabek (1987), building on theories by Pennings (1985) and Pfeffer (1982), has identified 15 strategies that emergency management directors use to improve the response capability and preparedness of their communities.Those strategies include approaches that are political, organizational, and strategic. He further found that the more successful managers regularly used more of the top five identified strategies than those who did not. Drabek's research demonstrates that there are identifiable core skill/knowledge sets that enhance a manager's ability to perform well.

One researcher in particular has focussed on the issue of professionalization in emergency management. Wilson (2000) examined this area in much detail in her dissertation, and found that while the emergency management profession is moving toward certification, there are neither objective standards one may apply, nor uniformity in the job requirements of an emergency management professional. She advocates following the certification approaches of other practitioner fields by establishing accredited education programs at the undergraduate and graduate levels, and focussing on formal educational requirement coupled with professional examinations.

Finally, Darlington (2000) has examined educational issues with respect to the emergency management field and has found great variance in how the topics are handled in universities. This is due to the placement of the program, the disciplinary approach of the home department sponsoring the courses, and the lack of faculty with practitioner experience teaching the courses.

ISSUES FACING THE PROFESSION

There are three key issue areas that appear to be driving much of the debate and discussion with respect to professionalization. First is the attempt, from both academic and practitioner perspectives, to understand just exactly what is the field of emergency management? Questions focus on such areas as: What is the scope of the field? Where should the function be placed in government? What job functions are appropriate to this position? These questions among others are raised as the emergency management field evaluates its role in society.

Second, given the varied requirements for the job of the emergency manager, what skills and knowledge are needed to effectively perform successfully in the position? Is there a core set of skills that can be agreed upon? Are emergency management positions similar enough to be able to specify a skill set that is sufficient for most positions?

Third, the issue of where the field should be headed in terms of education, certification, and accreditation of programs, both at the agency and university level, has been the subject of much attention. While it is clear that the demands of many emergency management positions point to the development of specific degrees and specializations within programs, there is little agreement as to best approach and how to apply uniform standards to such a wide variety of practitioner environments.

How these issues are resolved will shape the profession and the characteristics of succeeding generations of emergency managers. Within the academic literature on these topics, there appears to be a predisposition toward certification and formal education as requirements. While this may be the best approach for some circumstances, we suggest that there are alternatives to a blanket approach that will assist the field as it continues to develop.

DISCUSSION

Disaster and Community Diversity

There is an incredible variety of scenarios that emergency managers must face in their communities. Some communities are continually at risk, whether from flood, fire, earthquakes, or hurricanes, and others are exposed to multiple hazards. On the other hand, there are communities that rarely experience a disaster event, and the role of the emergency manager is to coordinate training and exercises. The range of hazard exposures combined with different sizes of populations creates variations in job complexity that increase by orders of magnitude.

The complexity of large urban environments, regardless of the exposure to hazards, complicates the job of the emergency manager. It does not do so uniformly, however, communities are unique, with their own characteristics and circumstances. The position requirements of an emergency manager in Los Angeles are quite different from those that might be found in a small Kentucky town. Some cities require large staffs to address the planning, preparedness, and response needs of that community, while in others the emergency manager might be a half-time position, or the job functions might be borne by the city manager or fire chief in addition to other full time responsibilities.

Increasingly, aspects of emergency management have become more specialized, meaning that it becomes more difficult to find the expertise needed to accomplish all of the tasks in one person. Understanding the intricacies of an unreinforced masonry ordinance as it relates to the community's historic preservation goals can be a specialized area of knowledge more appropriate to another department (planning, for example), yet emergency managers may be forced to deal with the issue as part of their job.

With these issues in mind, the creation of a standardized list of required skills or body of knowledge that would apply to the profession writ-large seems, at this point, to be inappropriate. Just as the profession is admonished to be more flexible in its response to disaster scenarios, so should there be a flexible approach to understanding the diverse needs of job positions that might be have the same job title or classification, but be extremely different in day-to-day activity.

Relaxing the Command and Control(led)

One theme that is often noted in the research is the need to break free from a "command and control" mind set on the part of the emergency manager. In the field, practicing emergency managers would not always agree that this mind set hampers their operations - as it works best in non-disaster scenarios. Once a disaster has exceeded local capacity, however, response plans and standard operating procedures tend to be quickly dropped and response becomes more oriented to flexible, newly-created processes and interactions that were not rehearsed in drills or exercises, yet do accomplish the tasks that are required. These emergent norms and organizations are far more the rule following a disaster than are organizations that can follow their response plan to the letter.

Perhaps one of the best ways to demonstrate this to emergency managers who have not yet been through a community-wide disaster would be to create a "paid-to-assist" program, in which FEMA or the State picks up the tab to bring in small teams of emergency managers from other places, particularly aimed at personnel who have yet to work in a post disaster environment.

In terms of achieving a mind set of "flexibility," however, it would be difficult under the current frameworks. The reward system for emergency managers is focussed on product (delivering "the plan," creating a well-equipped EOC) rather than process. There is little incentive for a manager to create partnerships, foster constituencies, and other "process" oriented tasks. What is needed here is demonstrable proof that the process-oriented activity reduces property losses or loss of life. Emergency managers need to be able to build a case for these activities within their community.

Linking Fire Tower to Ivory Tower

Another point noted in the literature in this area is the gulf that separates those researching the issues from those who are doing it day-to-day. There is no clear reason for this. Other practitioner-based fields have closer relationships with academia than does emergency management. It may be that the field of emergency management is growing toward that, or it might be the separation of theory and practice is more pronounced in emergency management than other fields. That is not to imply that there is no interaction. Several examples exist, such as the annual Hazards Research and Application Workshop, held for the last 26 years in Boulder, Colorado. The workshop intentionally mixes academics and practitioners in a workshop-setting in order to foster networking and better relationships.

In other conferences you find far fewer interactions. There could be more intermixing at conferences, in which a panel could address the needs of the profession for an audience of researchers, and vice versa. On both sides, there are opportunities to increase interaction. It could be an academic becoming involved with the local emergency management office (cooperative course projects, internships, assisting with planning tasks, and similar activity) or, alternatively, local emergency managers might be made more understanding of the process of research, and see it as a means of moving the profession forward.

A cooperative research agenda would be of use to both sides, in which the areas of research can be defined and prioritized as to the need and potential impact on the practice of the profession. Current research agendas are often the result of ad hoc research projects with no coordination among them, nor any clear indication that the projects are assisting with immediate needs of the field.

Determining and Delivering Core Skills and Knowledge

We suggest that a useful approach would be to identify the lowest common denominator of skills that are shared among the divergent emergency management professionals. This base standard would apply equally to any emergency manager, regardless of where the position is located. This process is happening to some extent as the field debates the concept of certification. One academic work that has examined that issue specifically was an unpublished doctoral dissertation cited by Wilson (2000: 221) entitled *A Study of the Core Functions of Emergency Management as Reflected in Training Requirements for Professional Certification*. This study is a step in reaching consensus regarding what should be included in that core set of skills, although we feel the assumption should not be made that the field is moving toward certification regardless.

Assuming that a base standard or "core" set of skills can be determined (and agreed to), the next step would be to identify and encourage differentiation and specialization beyond the base, as appropriate. As the field has aspects that have become more specialized, so too should education and training opportunities, recognizing that there is no single professional development track.

Just as important as the content that is delivered, is the delivery mechanism itself. As distance learning becomes more feasible via TTVN, the Internet, or through satellite campuses, courses can be delivered at a lower cost, and can be tailored to the needs of the students. Other alternatives would be for managers to register as "non-degree" or continuing education students. This would allow the manager to enhance their skill set without necessarily pursuing a degree.

Tiered Credentialing

A second recommendation is to create a "tiered credentialing" system. There is no question that the practice of emergency management has wide variations in job requirements. Instead of trying to fit certification around that diverse activity, it makes more sense to create a differentiated certification system with a range of tiers or levels. The tiers would be based on some combination of experience, skills, and education, and could be further adjusted to reflect the experience demonstrated for communities of varying size, complexity, and hazard exposure.

For example in a tiered system with three levels, Tier 1 would be certification that reflects competency for emergency management in a smaller city, with a few years of experience, and relatively few hazards. Tier 2 certification would reflect the skills needed and ability to successfully deal with the needs of a medium-sized city, more years of experience (with a number of those in medium sized cities), and experience dealing with multiple hazards. Tier 3 would be the highest certification, reflecting the skills needed to be an emergency manager in a large city or metropolitan region, and might also reflect a Masters degree with some specialization in hazards. While there would necessarily be a long process to determine the appropriate metrics for the various levels, it would be a means of addressing the variation that exists in the profession.

The initiation of a certification process of any kind will create some market-based pressures that will encourage job applicants to differentiate their skill set in order to stand out among other candidates. This was less of an issue in the past, but is becoming more an issue with the next generation of emergency managers, as there are more communities that are being built or expanding into hazard-prone areas, while at the same time more applicants are entering the field. As noted by Neal (2000), there are more university-based programs that offer courses (and therefore market differentiation) producing more competitive job candidates.

CONCLUSION

There are a number of issues in the profession of emergency management that require careful debate, utilizing the talents of experienced professionals and seasoned researchers. Current debates have a tendency to polarize the issues into opposing camps, and often neglect alternative approaches. In general, the field demonstrates growing pains as it seeks to establish itself as a clearly identifiable profession. More attention should be focussed on interim solutions, rather than attempting to solve the issues upfront. There is ample opportunity to improve the relationships between academia and practitioners, with one benefit being the development of appropriate course curricula to advance the knowledge base of the emergency management profession.

Based on the issues raised in this paper, there are three areas of research that would help clarify and advance understanding. First, additional comparative research should be conducted that examines the appropriate role and function of credentialing in emergency services as compared to other fields (Engineering, Planning, Architecture, for example).

Second, more research - ground-based and empirical - is needed that examines the required skill and knowledge base of an emergency manager, and the job tasks that are typical across a range of community types. This research would help in the creation of a tiered credentialing system by distinctly identifying the skill sets and capabilities that would predict the competence of emergency managers at varying levels.

Third and last, there is a real need for research that expands the understanding of how emergency managers can be better equipped, trained and educated to work with post disaster emergent norms and organizations. There are no established research protocols that would identify these skills, other than the researcher being a participant-observer in the post-disaster environment, documenting observed behaviors and characteristics of the emergency managers.

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NOTES

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THE STATE OF THE LOCAL EOC: A PRELIMINARY STUDY

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THE RESEARCH QUESTION

The Emergency Operations Center (EOC) has long occupied a central position in the emergency management programs of local jurisdictions. In many ways, the EOC has been the physical embodiment of civil defense and emergency management - but how much do we really know about modern emergency operations centers in local jurisdictions across the United States? The answer is surprisingly little. This study provides a preliminary examination of the state of local jurisdiction emergency operations centers in order to better characterize these facilities and contribute to an understanding of their role in emergency management.

THE LITERATURE ON EOCS

Government program facility-requirements have defined emergency operations centers in the context of either what a facility should be or in terms of what it must provide in order to meet government recognition standards. These are descriptions of either ideal facilities or of facilities that provide an acceptable capability to perform in a direction and control role (Crews 1995, FEMA 1984a, 1984b). This ideal emergency operations center can be characterized as a modern facility staffed by technical experts and decision-makers from all key government departments, led by the chief executive. Operations within the emergency operations center assure continuity of government (FEMA 1990), the effective development of policy and strategy, and the efficient direction of emergency response to protect the community. The emergency operations center is able to communicate with field resources and other jurisdictions, to manage information effectively, and to survive and continue to function during the worst impacts of a disaster. Training materials conform to these idealized facility descriptions (FEMA 1995b), as do basic texts in the emergency services (Perry 1991, Bahme 1978); and descriptions of new facilities typically extol improvisation in the face of limitations (Lunsford 1999), facility modernization (Anderson 1978, Spencer 1999), and conversion to the Internet (Sibley 1999), etc.

It is questionable, however, if the ideal facility is the operational reality. Anderson (1978) reported the inadequacies of emergency operations centers in the Pennsylvania floods of 1955 (an issue of size for the task) and during Hurricane Agnes in 1972 (where a key emergency operations center flooded). Dynes and Quarantelli (1975) suggested that the isolation of emergency operations centers and their nuclear war role actually limited their effectiveness as a coordination point in natural disasters. Quarantelli (1988) pointed out that, although almost all jurisdictions now had emergency operations centers, having the facility was not the same as having an effective integration of technology and organization (and that such integration was in fact lacking in many places). Dilling (1995) highlighted the importance of developing a model of coordination and communication that could effectively meet local needs. Averch and Dluhy (2000) suggested that the Dade County Emergency Operations Center did not serve as an effective seat of government policy and strategy development during Hurricane Andrew. Like Averch and Dluhy, Nigg (1997) highlighted problems in jurisdiction to jurisdiction coordination and the perceived inefficiencies of county level emergency operations centers in the context of the 1994 Northridge Earthquake.

The only large-scale study of emergency operations centers previously conducted was part of a mail survey on emergency preparedness issues of 2345 local and county emergency management officials conducted by Nehnevajsa in 1990. Questions regarding emergency operations centers were based on the Hazard Identification, Capability Assessment, and Multi-Year Development Plan instrument. This survey identified that 88.8% of the jurisdictions had an emergency operations center, even if the capability it represented was in many cases rather rudimentary. Table 1 summarizes key findings from Nehnevaisa's work.

Table 1: 1990 Emergency Operations Center Characteristics

Characteristic	Percentage
Measures in place to prevent unauthorized entry, vandalism, or theft	79.5%
Serves as warning point for state and federal warnings	77.3%
Facility is not located in a flood plain	76.3%
Activation can be completed within 15 minutes	75.1%
Facility has independent heating, ventilation, and air conditioning system	52.4%
Equipment is protected against power surges	51.0%
Space for staff is at least 50 square feet per person	48.4%
Facility has independent sanitary facilities	44.7%
Facility has a generator with a 14 day fuel supply	41.4%
Facility has 14 day stock of food, medical supplies, operational supplies, and parts for communications systems	30.7%
Facility has an independent potable water supply	27.6%
Facility also serves as a meeting room	21.5%
Facility also serves as a training room	16.5%
Facility protects its systems against electromagnetic pulse	14.4%
The facility is mobile	10.3%

Source: Jiri Nehnevajsa. Emergency Preparedness: Reports and Reflections of Local and County Emergency Managers. Washington, DC: Federal Emergency Management Agency, 1990, pp 48 and 50.

Where do emergency operations centers stand today? Are improvements, refinements, and new approaches a significant issue in emergency management, or is the status quo the norm? One source may prove useful in answering these questions. FEMA's *Partnerships in Preparedness: A Compendium of Exemplary Practices in Emergency Management* (1995, 1997, 1998, 2000) presents national best practices in current local and state emergency management programs. Of 184 exemplary practices noted over six years, five (2.7%) involved emergency operations centers. All involved either programs to staff the emergency operations center or the organization of staff and functions within the center.

STUDY METHOD

Population and Procedure

Eight states were chosen as the source of local jurisdictions for study based on a convenience sample of lists of local emergency management agencies available on Internet sites. The states represented seven of ten Federal Emergency Management Agency Regions, and include two Western, two Mid-Western, two Northern, and two Southern states (see Table 2). In December 2000, a two-page questionnaire was mailed to each local emergency management agency listed, a total of 641 questionnaires (not including 7 returned as undeliverable). Of this number, 51.8% (n=332) resulted in responses by local emergency managers.

Table 2: Survey Distribution and Return Rates

FEMA Region	Area	State	Questionaires		Percentage of	
			Sent	Returned	State	Sample
I	North	Maine	16	13	81.3%	3.9%
II	North	Pennsylvania	68	51	75.0%	15.4%
IV	South	South Carolina	46	30	65.2%	9.0%
IV	South	Tennessee	99	40	40.4%	12.0%
V	Mid-West	Illinois	167	68	40.7%	20.5%
VII	Mid-West	Iowa	95	49	51.6%	14.8%
VIII	West	Colorado	92	44	47.8%	13.3%
IX	West	California	58	36	62.1%	10.8%

Note: One survey was returned with no indication of state of origin.

Responses were tabulated using the Statistical Program for the Social Sciences (SPSS) Version 10.0 and basic descriptive statistical methods were applied. The median (middle value in a scale from smallest to largest value) was selected as the primary measure of central tendency because it reduces the impact of unusually large or unusually small outlier responses.

Limitations

It is important to note that it is possible that data reported in this article may reflect a higher level of capability than is actually the case - agencies that did not respond to the survey may not have responded because they lack effective emergency management programs or an emergency operations center. There was considerable variability in the degree of completion of the questionnaires, with responses to individual questions ranging from 332 to 224. Even though the questionnaire was based on standard descriptions of emergency operations centers in Federal Emergency Management Agency manuals and training materials, at least one respondent commented that he or she was unfamiliar with most of the terminology used in the survey.

RESULTS

Primary and Alternate Emergency Operations Centers

The respondents described their emergency operations centers as primarily serving combined city and county (41.3%, n=137) or county agencies (44.0%, n=146). Of the remainder 7.8 % (n=26) were city agencies, 3.6% (n=12) village agencies, 0.9% each from operational areas (n=3) and towns (n=3), and 0.3% (n=1) from townships.

Among responding jurisdictions, 97% (n=322) reported having an established primary emergency operations center. When asked if there was also an alternate emergency operations center, 85.5% (n=284) of the jurisdictions replied that an alternate had been at least identified. The survey data also reflects that what constitutes either a primary or an alternate emergency operations center is highly variable (see Table 3).

Among primary facilities, 52.6 % (n=168) fit in the category of space which was temporary (through conversion of conference rooms during an event or through pre-planned development of dual use rooms that meet other primary uses), but which was configured with features needed when activated as an emergency operations center. A surprisingly large percentage (30.4%, n=97) of the facilities, however, were built specifically to serve as emergency operations centers.

Among alternate facilities, there was a heavy reliance (30.2%, n=86) on other organizations as back up facilities, either another agency's emergency operations facility within the jurisdiction or another jurisdiction's emergency operations center. The temporary space solution (conference room and dual use room) was also popular for alternates (35.9%, n=102).

When respondents were asked to identify the facilities present within their emergency operations center, the results further heightened the variability of what is considered to be an emergency operations center. Using a list of specific types of spaces identified from descriptions of ideal emergency operations centers, the median emergency operations center had 5 of 13 categories of space. The spaces most frequently identified were bathrooms (90.5%, n=287), a communications center (85.5%, n=271), and administrative office space (79.1%, n=250). The high percentage of facilities with communications centers may be explained by several notations on questionnaires that the emergency operations center is located next to or in the same building as the jurisdiction's public safety answering point. Operations rooms were included in 73.5% (n=233) of the facilities. Support spaces required for sustained operations were not as commonplace: kitchens, 66.3% (n=211); showers, 57% (n=74); dining area, 42.9% (n=136); dormitories, 23.3% (n=74); and clinics or first aid rooms, 3.1% (n=10). In only a very small percentage of cases did the emergency operations center have a capability for sustained operations in a contaminated environment; 7.8% (n=25) had a specific decontamination area, and 2.8% (n=9) reported having an airlock.

Table 3: Types of Primary and Alternate Emergency Operations Centers

Emergency Operations Center			Alternate Emergency Operations Center		
Facility	Number	%	Facility	Number	%
Dual Use Room	98	30.7	Other Agency's	68	23.9
Purpose- built EOC	97	30.4	Conference Room	60	21.1
Conference Room	70	21.9	Dual Use Room	42	14.8
Shared with PSAP	39	12.2	Mobile CP	41	14.4
Normal Office Space	9	2.8	PSAP	28	9.8
Designated Building	5	1.6	Other Jurisdiction's EOC	18	6.3
Coordinator's Home	1	0.3	Designated Building	17	5.9
			Normal Office Space	7	2.5
			Former EOC	3	1.1

Note: EOC indicates Emergency Operations Center, PSAP Public Safety Answering Point or dispatch center, and CP Command Post.

Threats and Survivability

Emergency operations centers, like their jurisdictions, exist in a hazardous world. Although 18.8% (n=60) of respondents reported that their emergency operations center was not located in a hazard area, the remaining 81.2% faced one or more hazards as shown in Table 4.

The median primary emergency operations center was constructed or renovated in 1993 Approximately 50% (n=132) of the responding facilities were less than eight years old, including eight currently under construction. The oldest building, however, was constructed in 1823, with eight predating the Cold War.

Table 4: Emergency Operations Center Hazards

Number of Hazards	%	Cases	Specific Hazard	%	Cases
0	18.8	60	Transportation Route	65.2	208
1	51.7	165	Hazardous Facility	21.9	70
2	21.8	69	Near Fault Line	11.5	37
3	7.2	23	In Flood Plain	9.7	31
4	0.3	1	Nuclear Power Plant	6.3	20
5	0.3	1	Civil Disturbance	2.2	7
			Others (7 types)	2.8	9

Note: The figures for transportation route hazards may not reflect the full range of the threat. For the purposes of the survey I used 1 mile as a reasonably conservative criteria. A review of the North American Emergency Response Guide shows a substantial number of hazardous chemicals with downwind protection zones that exceed 1 mile for large spills.

The construction of the majority of Emergency Operations Centers during the post-Cold War period could be expected to mark a clear demarcation between underground, bunker facilities and above ground modern offices. This is not the case. Of 321 emergency operations centers, 35.8% (n=115) remain underground; the majority of facilities (63.8%, n=205) were located on the ground, or higher, floors.

When emergency operations centers constructed or renovated after World War II are examined (1990 is used as the end of the Cold War, rounded up from November 1989) (Miller 1998), an interesting pattern emerges (see Table 5).

Table 5: Underground EOCs - Cold War and Post Cold War Comparison

Dates	Above Ground	%	Rate	Underground	%	Rate
1950-1989	40	45.9	1.0	47	54.0	1.2
1990-2001	176	80.7	14.7	42	19.3	3.5

Note: The Rate reflects the mean (average) number of facilities being constructed or renovated per year in each category. The exact date of the start of the Cold War could be argued, but for the purpose of this study the argument is rendered moot. No respondent identified an emergency operations center as having been constructed or renovated between 1935 and 1950.

Even in the days when fallout and blast protection were important considerations, the data suggests that a sizeable percentage of emergency operations centers at the local jurisdiction level may not have been hardened. In addition, the percentage of newly constructed or renovated emergency operations centers that are underground has significantly decreased. These very tentative conclusions may not reflect decisions of jurisdictions to move out of old, underground emergency operations to above ground facilities, however. Underground facilities are still being built. The rate at which facilities are put underground appears in this sample to be higher than in the Cold War period, as does the overall rate of construction of emergency operations centers. Additional research is needed to determine the causes of these apparent changes.

Of the above ground emergency operations centers, only 27.9% (n=45) of those responding were housed in the interior core of the building in which they were located - 72.1% (n=116) had at least one exterior wall. Of the facilities with an exterior wall, 72.4 % (n=84) were reported as having windows. The high percentage of above ground facilities is a cause for concern in any area subjected to high winds. This concern increases where there are exterior walls and to an even higher degree where there are windows. In addition, the use of exterior walls and windows would seem to raise significant survivability concerns in terms of vulnerability to terrorist attack.

These survivability concerns are not restricted to walls and windows. When specific survivability measures were examined, the median emergency operations center had two of eight possible features. The most popular feature was an emergency generator (93.4%, n=297), followed by reinforcing of facility walls and ceilings (43.1%, n=137), and use of battery back-up power (34.9%, n=111). Few facilities had features that logically would have provided enhanced survivability under nuclear attack conditions: blast doors (3.5%, n=11), radiation shielding (13.5%, n=43), air filtration systems (21.4%, n=68), independent water supply (20.1%, n=64), or independent sewage system (7.5%, n=24).

When emergency managers were asked how long their emergency operations center could operate if cut off from support, answers ranged from 0 days (25.5%, n=65) to 60 days (0.4%, n=1) with a median of 3 days. When specific supply stocks were examined, however, the median emergency operations center stocked only two of five types of critical life support supplies. Among respondents, the most common supply stocked was fuel (60.7%, n=164), followed by water (50.0%, n=135), and food (44.8%, n=121). First aid supplies (32.5%, n=88) and sanitation kits (15.9%, n=43) were relatively uncommon.

Access to emergency operations centers was controlled in 90.3% (n=289) of the emergency operations centers, with the median facility having two methods of access control. Some facilities had as many as five methods of securing entry (5.2%, n=16). The most common method was the use of a guard (50%, n=155) The second most common was the use of a locking vestibule (48.7%, n=151), followed by closed circuit television (41.6%, n=129), card access (36.1%, n=112), and perimeter fencing (24.2%, n=75).

Information Management

Because emergency operations centers are fundamentally information management facilities, the ways in which information is received, processed, and made available for decision-making are critical to understanding their capabilities. Responses to the question that addressed communications capabilities, therefore, potentially reflect what emergency operations centers can accomplish in actually managing emergency operations. Among responses, emergency operations centers ranged from one to ten communications systems, with the median facility having five methods available. Three facilities reported a telephone was not available within the emergency operations center; however, the telephone was the predominant communications device in use, with 99.1% (n=318) having at least one telephone. The facsimile was the second most common device (89.7%, n=288). Considering the amount of material that moves by facsimile, this was a surprising finding, and bears more investigation of the data to determine which types of facilities did not have this capability. For wireless telephone systems, 76.9% (n=247) reported use of cellular telephones and 35.8% (n=115) use of satellite telephones, a higher figure than penetration of satellite telephones into the general telecommunicat-ions market would lead one to expect. Among radio systems, the first choice was local public safety (87.2%, n=280), followed by amateur (69.7%, n=224) and government high frequency (49.8%, n=160) radio. Surprisingly, considering the collapse of Channel 9 monitoring, Citizens Band radios are still found in 23.1% (n=74) of the facilities.

The most interesting communications component was the degree to which respondents reported the use of computer-based electronic communications, specifically e-mail and the Internet. In 85.0% of emergency operations centers the Internet plays a communications role. When respondents were asked whether computers had been integrated into the emergency operations center, however, only 55.3% of emergency operations centers reported being computerized. This suggests either that Internet access may be outside the emergency operations center or that computers are used for e-mail, and possibly administrative work, but not for operations functions.
This is confirmed when responses as to the use of emergency management software are considered. Of the 177 computer users, 48% (n=85) or 26.5% of the overall number of responding emergency operations centers used an emergency management software. The software systems in use in the greatest number of cases were: EIS (n=23), CAMEO (n=15), the California Response Information Management System (n=11), and EM2000 (n=10).

When software users were asked the percentage of their personnel who they considered to be really proficient in the use of the emergency management software installed in the emergency operations center, the median staff is 20% proficient. If we arbitrarily assume that 50% proficiency is needed to fully exploit complex software capabilities and provide on-the-job training by coaching to personnel unfamiliar with the software, 34.6% (n=26) of the staffs met an operational proficiency level. Applying 34.6% to the 26.5% of emergency operations centers that use emergency management software suggests that 9.2% of emergency operations centers may be considered to be capable of effectively using computers to manage disaster operations. Although this is a simplistic analysis, it is a cause for concern and highlights another area for additional study.

Visual displays have long been a component of how emergency operations centers manage information; the median emergency operations center used four visual aids, and in four cases eight types of aids were in use (although in five cases no visual aids were used). Maps (90.8%, n=288) and whiteboards (77.6%, n=246) are the dominant visual aids. Standard status boards were relatively infrequent (47.3%, n=150), highlighting the temporary use nature of many facilities. One surprising result deserves consideration; television is available in 66.2% (n=210) of these centers. Considering the importance of television based news and weather services for information gathering and the need to monitor news as part of rumor control functions, it is not reassuring to realize that 33.8% of facilities lack this capability.

Organizational Structure and Staffing

From the literature, four common organizational structures can be identified as being used in emergency operations centers: the traditional four group structure (policy group, operations group, resources group, and disaster analysis group), the incident command system (in a wide variety of forms), emergency support functions, and organization by existing government departments (the emergency staff-meeting model). Responses indicated that the incident command system (in any form) is the most common organizational structure, being used in 33.3% (n=195) of the facilities. The traditional four group structure, described in the Emergency Operating Centers Handbook (FEMA 1984a), was used by 21.3% (n=67); a structure based on normal department organization of the jurisdiction's government was used in 18.4% (n=58) of the cases; and the emergency support function model was used in 13.3% (n=42) of the facilities. In addition, in another 13.6% (n=43) of the cases the respondents reported that a combination of organizational structures was used.

When supervision of the emergency operations center was examined, the senior individual responsible for managing the vast majority of centers (78.7%, n=251) was identified as an emergency management coordinator (although it is important to note that coordinators may have wide variability in job description and authority). In 168 cases the chief elected official, and in an additional 10 cases another elected official, of the jurisdiction is present in the emergency operations center. In 57.2% of the emergency operations centers an elected policy maker is present at least part of the time.

Emergency Operations Center staffing patterns remain a significant issue. In 25.5% (n=78) of the cases, respondents indicated no set shift length and that staffs worked until they could no longer work anymore. In another 55.5% (n=170) of cases, twelve hours shifts were the standard. In sum, in 80% of emergency operations centers, staffs are working shift lengths than can be expected (absent any other stress inducers) to result in significant fatigue, elevated stress levels, and poor decision-making during disaster events (Green 2001).

The actual size of emergency operations center staffs is highly variable, and is shown in Table 6. Although the size is variable, there is relatively close commonality in size between staffs in actual and exercise events, indicating that the same functions may be generally represented both in training and in disaster response.

Table 6. Size of Emergency Operations Center Staffs

Event Type	Smallest Staff	Largest Staff	Median	Central 50% Range
Exercise	1	150	12	6-24
Disaster	1	150	12	8-22

Note: The Central 50% Range (interquartile range) reflects all emergency operations centers that fell from the 25th to 75th cumulative percent in staff size - it thus serves as a representation of the size range of the middle portion of the scale and could be considered typical. The median represents the value at the 50% mid-point on the scale, with half of centers having more staff and half fewer.

Operations

Even in disaster prone jurisdictions, emergency operations centers are not activated on a daily basis, although some jurisdictions clearly activate their facilities more frequently and for a wider range of events than others (see Table 7). For example, 6.7% (n=21) of respondents indicated that the emergency operations center had not been activated in the last three years. One jurisdiction reported that the last exercise was held 120 months prior to the survey and another that the last disaster was 156 months prior. Two jurisdictions reported 75 and 80 activations in the last three years, however, and approximately 26% had held an exercise in the last three months (n=62) or responded to an actual event in the last six (n=68).

Table 7. Emergency Operations Center Activations

Event Type	Most Frequent	Least Frequent	Median Frequency	Central 50% Range
Last Exercise	This Month	120 Months Ago	7 Months Ago	3-12 Months
Last Disaster	1 Month Ago	156 Months Ago	13 Months Ago	6-24 Months
Activations Last 3 Years	80	0	3	1-5

Note: The Central 50% Range (interquartile range) reflects all emergency operations centers that fell from the 25th to 75th cumulative percent in frequency - it thus serves as a representation of the frequency range of the middle portion of the scale and could be considered typical. The median represents the value at the 50% mid-point on the scale.

In examining staff experience by asking respondents the percentage of the staff that will serve in the next event that they would expect to have had previous experience in the emergency operations center, several interesting results emerged. In ten cases, the emergency manager expected none of the staff to have experience; in 67 cases (22.9%) the expectation was that 100% would be experienced. The modal value (the most common response) was in fact a 100% experience level, but there was another spike in values at 50% experience (n=43); and the median value (the mid point in the distribution) was that 78% of the staff would be previously experienced. This indicates that emergency operations center staffs have largely been exposed to disaster operations, either in actual or exercise events, even though these events are not common for most jurisdictions.

Interesting Artifacts

Although not a subject of this study, one interesting experience from the mail survey portion of the research deserves mention. A questionnaire, addressed to an agency with an apparently rural address, was returned marked "Deceased." We do not normally think of government agencies as being deceased - this suggests how personalized the emergency management programs of smaller jurisdictions may be.

One emergency manager reported that he or she did not need an emergency operations center because it was possible to run any disaster response the jurisdiction might require from the department's four-wheel drive sport utility vehicle.

One emergency operations center was located in a trailer.

One emergency manager reported that the emergency operations center, located in the basement of his house and staffed by one person, was inadequate for disaster response.

CONCLUSIONS

As might be expected by the variable nature of emergency management programs across the United States, there appears to be considerable variability in the design, equipment, survivability, staffing, and functions of emergency operations centers. Few centers appear to meet the ideal described in the literature (or, I would suggest, the desired standard of most professional emergency managers). The high percentage of responding jurisdictions that had both emergency operations centers and alternate emergency operations centers, however, is a positive outcome, even if those facilities do not necessarily conform to an ideal configuration.

The vulnerability of emergency operations centers is a cause for some concern. Relatively few are hardened facilities with features that ensure survival and with adequate facilities and supplies to sustain operations by a full staff in a prolonged emergency. Although hardened facilities could be viewed as obsolete Cold War relics, three emerging threats suggest that the need for a high level of survivability is not an outdated concern. First, experience in urban tornadoes has demonstrated the vulnerability of modern building construction to failure in high winds (Ballman 1999). Similar concerns surfaced in the aftermath of Hurricane Andrew (Florida Public Health Information Center 1993). If an emergency operations center is to coordinate community response, it must survive to do so. Second, we are currently devoting considerable attention to terrorism as the primary threat for the immediate future. At some point, terrorists may realize the degree to which command and control facilities, such as emergency operations centers and dispatch centers, are lucrative secondary targets. Finally, the United States is now embarking on a national missile defense program. The level of spending involved implies a real and growing threat and raises the legitimate question of the survival of key facilities if the ballistic missile defense system fails to account for all attackers.

While not all threats can be controlled, some clearly can be. The location of 9.7% of emergency operations centers in flood plains shows that, in some cases, emergency management does not practice what it preaches. The impact on a jurisdiction's ability to respond to a disaster when it loses the emergency operations center to flood waters was clearly demonstrated in Franklin, Virginia, during Hurricane Floyd in 1999 ("Dynamic Duo pummels Virginia" 1999) - and the impact is severe. Moving out of the flood plain, if financially and administratively possible, seems a commonsense mitigation tactic that can pay real dividends in ensuring effective response.

Emergency operations centers are well supplied with communications for information gathering and dissemination. The level to which data and information management procedures remain a verbal and manual process is a source for concern, however . The low percentage of facilities using even rudimentary emergency management software, combined with the even lower proficiency level, means that information may not be used as effectively as it could be in supporting decision-making. At the same time, anecdotal experience suggests this may be a natural outcome of the relative infrequency with which emergency operations centers are activated and the difficulty of training occasional staff members in the use of sophisticated software.

The variety of models of internal organization for emergency operations centers is interesting and may reflect a variety of factors. The reported use of an incident command system in many facilities suggests the potential for more effective integration of field response with emergency operations center policy-making, resource allocation, and logistics operations. It would be interesting to compare state use of the incident command system organizational model with that of local jurisdictions to determine the degree of vertical integration being achieved.

Logically an emergency operations center is a jurisdiction's seat of emergency government. The absence of the key elected officials, however, from a sizeable number of emergency operations centers suggests that these facilities are not used in policy and strategy roles in many jurisdictions. This concern is supported by staffing levels in many facilities that do not suggest the presence of a full range of governmental functions. An emergency operations center which concerns itself only with resource acquisition, allocation, and accountability issues, and which does not facilitate a strategic approach to the management of community response to disaster, would seem to reflect a wasted opportunity to integrate information and decision-making.

This article reports the preliminary analysis of data from a preliminary study of emergency operations centers. Even as a preliminary study, this data indicates there is clearly room for improvement of emergency operations centers as sites for emergency government, policy and strategy setting, and continuity of government in disasters. At the same time, this examination suggests that there is still much work to do in describing and understanding one of the key components of local jurisdiction preparedness and response.

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NOTES

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EXPECTATIONS AND RESPONSE TO NATURAL HAZARDS: AN ECONOMIC PERSPECTIVE

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INTRODUCTION

Rapid growth and migration along the southeastern coastline of the United States has exposed millions of people to hazardous situations of which they have little familiarity. Just as Sunbelt cities and their long-time residents are ill-equipped to handle winter snow and ice storms, new coastal residents may be ill-prepared to understand and cope with the hazards of hurricanes, tropical storms, and flooding. Several questions arise within this context; how aware are new residents of the potential hazards that they face, how much does the hazard affect their decision to relocate or remain within a particular area, and do market prices and transactions reflect or incorporate these hazardous situations.

Studies such as those by Greenwood, McClelland, and Schulze (1997), and Smith and McCarthy (1994) seek to address the first of these questions related to migration and location decisions. The first study finds that migration decisions may be influenced by the presence of a known hazard agent where the hazard situation is one of the attributes of a particular community. Their analysis focused on the siting of a nuclear waste storage facility, a technological hazard, and within this context they found that younger age groups were more influenced by the hazardous waste site than older demographic groups. On the other hand, studies such as Smith and McCarthy (1994) in their analysis of the post-Hurricane Andrew experience tend to find a temporary reduction in population with only minor, if any, impact on trend population growth on the impacted community.

Hedonic pricing studies of housing markets in hazardous zones and insurance market studies have attempted to address the second and third questions. Studies by Frame (1998), Kunreuther (1996), Kask and Maani (1993), Murdoch, Singh, and Thayer (1993), and Palm and Hodgson (1992) have all investigated this issue of how prices reflect these hazardous situations. The evidence is mixed, and while the hazardous situation and various attributes related to the hazard may exert a negative effect on housing prices, it does not appear to be a strong result, nor have these negative attributes prevented development and growth within these hazardous zones.

The issue comes down to one of perceptions and expectations. What do current and potential residents perceive the risk to be? How do they form these perceptions of risk and expectations? And lastly, how do their perceptions of hazard risk and expectations affect their location choices and their behavior towards the hazardous situation?

RISK, LOCATION, AND HOUSING CHOICE

Households are assumed to make residential location and housing decisions in order to maximize utility given a set of housing amenities and their consumption of other goods, subject to a household budget constraint. Additionally, households make their housing and location choices given their set of subjective expectations of the relative risk of the occurrence of a natural hazard and the level of event severity. Observed market outcomes include situations where some households choose to avoid hazard prone areas altogether; others decide to locate within a hazardous zone, but choose to take no, or very limited preventative measures; and still, other households may undertake a greater degree of pre-event mitigative measures.

Mathematically, the consumer choice problem is as follows:

$$\text{(1)} \qquad maximize\, U = U(H,X),$$

subject to the budget constraint,

$$\text{(2)} \qquad Y - kX - \pi(H) = 0,$$

where H represents a vector of housing attributes, X, a composite good, representing the consumption of other goods, k, the unit cost of the composite commodity, $\pi(H)$, the price of housing, and Y stands for household income. Kask and Maani (1992) modify this framework by normalizing the price of the composite good (k) equal to one, and using the budget constraint, Equation 2 to substitute for the composite good 'X', to analyze the consumers subjective probability by maximizing the expected utility function for H, and r as:

$$\text{(3)} \qquad E(V) = p(p^{e},r,i)V_0(H,Y_0 - \pi(H) - r) + (1 - p(p^{e},r,i))V_1(H,Y_1 - \pi(H) - r),$$

where 'r' is spending on mitigative or protective measures undertaken by the consumer, 'i' represents the level of information consumers have about the hazardous situation, and p^e is the consumer's subjective probability of a hazard event. V_0 and V_1 represent the value of the expected utility function in the event of a natural hazard occurrence, state '0', and in the absence of the natural hazard event, state '1'.

Murdoch, Singh, and Thayer (1993) restate the consumer choice problem as:

$$\text{(4)} \qquad maximize\, U = U(R,H,X),$$

subject to the budget constraint,

(5) $$Y - kX - \pi(R,H) = 0,$$

where 'R' represents the level of risk associated with the particular hazard. From the first order conditions they derive the hedonic price function:

(6) $$\pi = \pi(S,N,R),$$

where home prices are a function of site characteristics 'S', neighborhood characteristics 'N', and risk factors. Taking this analysis one step further, Frame (1998) includes variables for hazard severity and commuting distance from a central business district.

One of the primary problems for the consumer is how much weight to give to the hazardous situation. In forming their subjective expectations, consumers will consider information from a variety of sources. Not only must consumers form expectations about the likelihood of an event occurrence, but if they are going to undertake any type of preventative measures, they must also draw conclusions regarding the severity of the event.

WEIGHTING THE HAZARD

The utility maximizing framework does not clearly address the mechanism by which households arrive at their particular weighting, or subjective expectation. In the absence of well-defined loss functions from the natural hazard event, what types of strategies can households adopt to form their expectations. Additionally, given a situation where preferences are partially determined by the market, how households obtain information and the source of that information can have a dramatic impact on these expectations.

The first order conditions to Kask and Maani's utility maximization problem are:

(7) $$\pi_H = \frac{pV^0{}_H + (1-p)V^1{}_h}{pV^0{}_X + (1-p)V^1{}_X},$$

and

(8) $$-p_r(V^1 - V^0) = pV^0{}_X + (1-p)V^1{}_X$$

leading to the result that households should equate the price of household characteristics to the marginal rate of substitution between the characteristics and the price of good 'X' (1992, pg 172). Choosing a level of self-protection consequently forces households to adjust their consumption of other goods in such a way that the marginal benefit of reducing expected losses is equal to the marginal cost. They focus their analysis on the bias that arises in the subjective probability that households assign to the hazard due to uncertainty.

Some of the problems that consumers may have in properly assigning probabilities arise from ordering and transforming information from the market into a useful fashion. Where does their information come from - expert opinion, anecdotal evidence, stories from television or the newspaper, personal experience with the hazard (Quarentelli, 1984). Additionally, how is the information presented (Greenwood, McClelland, and Schulze, 1997) . Starmer (2000) points out that the ordering of the information, and how possible outcomes are framed will affect the decision process and the assignment of subjective probabilities.

The market can determine household preferences in two very important ways; by framing the choices open to consumers, and through the establishment of market "norms" (Bowles, 1998). Households make their location and housing choices in reference to the location of roads and transportation networks, shopping, schools, and other amenities which are collectively determined in the marketplace. Consumers must consider issues such as the market rewards from activities like building in hazardous zones, ie beachfront development, and the mechanisms the market has developed to ameliorate the hazard. While households may be able to reduce their level of exposure by moving outside of the hazardous zone, they may in the process be reducing potential earnings, as well as profits from their investment in residential real estate. These effects will impact the potential loss function households face, as well as their subjective expectations.

Learning takes place through the observation of behavior in the marketplace (Bikhchandani, Hirschleifer, and Welch, 1998; Mailath, 1998; Lam, 2000). Whether individuals have a desire to imitate others, or they are simply trying to garner information from the market, observations of the choices made by others serve as signals to households. Choosing restaurants based on others' opinions, or by observing whether it appears to be busy are examples of this type of behavior. By extension, housing and location choices as well as consumers willingness to spend on mitigation may be predicated on their observations of the households around them.

Residents adopt what are perceived to be successful strategies, given their observations of behavior in the market. Individual experience, institutional and public policies, will influence current and potential residents' view of whether to move or remain in a hazardous zone.

Individuals within the community interpret the same signals or information differently. At that point, they must convert that information into some type of subjective expectation leading them to make decisions about the types of mitigation spending to undertake. Short-sighted residents may decide to forgo structural improvements, or under-insure themselves, in the belief that risk of the event striking their home is low, or that government will step in with some form of aid to rebuild. Additional spending on structural improvements, insurance, and other housing amenities, leads to reductions in spending on other goods.

While the expected utility framework does not fully explain the behavior of households towards the hazardous situation, it does provide a flexible means of understanding some of the problems that individuals face in making their decisions. Information, "i", enters the expected value function in Equation 3, 7, and 8 in the form of market signals of observed behavior, level of education, news reports from various media outlets, government agency notices and warnings, and other similar means. This information influences the household's expectations function.

Additionally, the households current level of spending on preventative measures affects both its loss function in the event of a disaster situation as well as the level of its subjective expectations regarding the hazard that it faces. The household as well will hold some endowed 'a priori' level of expectations 'p^e' that enter into the overall expectations function.

In terms of the market signal model, the historic record of catastrophic events may not provide an adequate basis for forming expectations as individuals may place more weight on recent events than on past events. The problem for the household is that there is no way to determine the severity of any particular event until it occurs. While households may be fairly capable of handling low level hazard events under the current institutional and market framework, given insurance, zoning, and building codes in the developed world, catastrophic events are much more difficult to mitigate and plan for.

Households in communities that have experienced a recent event, or low level event, may feel that they are somehow immune for a time, or that their defenses have been satisfactorily tested. Unfortunately, as the cities of Pensacola, Florida or Wilmington, North Carolina can attest to, the same hazard can strike within the same general area repeatedly in a very short period of time, as with Hurricanes Erin and Opal in 1995 on Pensacola Beach, or back to back hurricanes in North Carolina in 1997 and 1999.

Mitigation and insurance protection for residents may be quite costly given the actual event probabilities, thus leading to policies to subsidize the coverage (Kunreuther 1978; 1996; Palm and Hodgson 1992). In the absence of these types of policies, as Burrus, Dumas, and Graham (2001), demonstrate, households may decline to undertake any preventative measures at all, given the cost of pre-event mitigation and the potential post-disaster losses.

CONCLUDING REMARKS

Much debate surrounds the growth of communities in hazard prone areas. Public investment in structural improvements such as flood control, and beach and shoreline protection, are viewed as a contributing factor subsidizing and thus helping to drive this growth (Cordes and Yezer, 1998). Policies like subsidized flood and earthquake insurance, and even the strengthening of building codes and zoning regulations have all been considered as aiding growth in hazardous zones (Palm and Hodges, 1992; Hageman, 1983). While there may be some validity to the argument that these programs have made it easier to live within a hazardous zone, and consequently had the unintended side-effect of increasing growth, their principal aim is in the reduction of loss of life and property from both catastrophic and average hazard events.

Public subsidization or policy is not the only factor responsible for this growth though. Households, through the process of utility maximization, make choices regarding where they should live and how much to invest in mitigation and other activities. Subsidies enter this process by adjusting some of the costs that households face in making these decisions. Individuals must still make their decisions in light of their subjective expectations regarding the hazard situation. The greater that households perceive the risk to be, the more likely they are to undertake some preventative measures. Alternatively, the more that prices reflect the true cost of the hazard situation, households will be less able to discount or ignore the hazardous situation in their utility function.

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NOTES

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INTEGRATING STANDARDS, PLANS, AND MANAGEMENT SYSTEMS

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INTRODUCTION

This paper describes an approach for developing comprehensive emergency management programs for health care systems that integrates the best practices of the emergency management (EM) community.

The problem is disaster preparedness in the US health care industry is primarily a compliance-based activity undertaken to pass accrediting surveys by oversight groups such as the Joint Commission on the Accreditation of Healthcare Organizations (Joint Commission, JCAHO). Disaster research has reported for twenty-five years that the health care system has remained disconnected from community preparedness efforts. To compound the problem, changes in the health care industry over the last decade due to economic pressures are believed to have reduced what little attention had been being paid to this activity.

This discussion is limited to describing how the Department of Veterans Affairs (VA) integrated the "top ten" EM principles and practices to provide health system planners with a roadmap for EM program development, maintenance, evaluation, and education (see Diagram One).

This paper describes a historical perspective of the emergency preparedness of health care systems in the US, VA's role in EM, recent changes to EM standards, and how these standards can be integrated with planning models and management systems to assist health care systems in developing more effective programs.

EMERGENCY PREPAREDNESS OF AMERICAN HEALTH CARE FACILITIES

Organized approaches to providing health and medical services in disasters began when emergency medical services (EMS) systems were formally created in 1973 (Public Law 93-154). Disaster linkage encouraged preparedness activities of EMS providers, hospitals, and support agencies. Researchers such as Tierney (1987) reported on problems with EMS delivery in disasters and preplanned events but concluded that creating effective service delivery did not require advanced technology or large financial investments, only increased communication, interaction, planning, and cooperation.

Seven years later, Tierney checked up on the status of the development of EMS systems and found little attention was being paid to disaster linkage in system design and planning, and that medical sector disaster planning was isolated from community emergency preparedness efforts. Hospitals tended to focus on the guidelines of the Joint

Commission (Tierny 1985)

Since that time, significant changes have occurred in the health care industry. Economic forces have transformed the manner in which health care is delivered, from in-patient to ambulatory care, and reductions in health care staffing and "just in time" delivery of supplies and equipment have resulted in less capacity for a surge of patients from a disaster. A recent observation by the same researcher is not optimistic that any significant improvements have occurred in the preparedness of hospitals. "No research has been conducted on how the changes in health care are affecting planning for disasters, but since disasters never were a major priority for most EMS organizations, it can probably be assumed they have moved down on the agenda." (Tierny 1999)

The Joint Commission became aware of the problem and issued revised standards for EM programs in 2001, strongly encouraging joint planning with the community and advocating use of mainstream EM concepts and systems (see Diagram Two).

The Department of Veterans Affairs

VA consists of three organizations: the Veterans Benefits Administration, the Veterans Health Administration and the National Cemetery Administration. The Veterans Health Administration is the largest integrated health care system in the US, providing health care to veterans through approximately 180,000 staff, 173 medical centers, over 771 ambulatory care and community based clinics, 134 nursing homes, 42 domiciliaries, 206 readjustment counselling centers and various other facilities. In addition to its medical care mission, the veterans health care system is the nation's largest provider of graduate medical education and one of the nation's largest medical research organizations. VA's fourth mission is to provide contingency support to the Department of Defense, the Federal Emergency Management Agency under the *Federal Response Plan*, and the Department of Health and Human Services for the National Disaster Medical System.

Emergency Management Strategic Healthcare Group. The contingency support mission is the responsibility of the Emergency Management Strategic Healthcare Group (EMSHG). For the last ten years, EMSHG has provided leadership in EM programs for the health care industry. This leadership is based on its extensive contingency experience (eg the Gulf War, most Presidentially-declared disasters that require health and medical support, and major mass gathering events) as well as its work in bringing the various stakeholder agencies and organizations together in training and educational program design and delivery (eg the National Disaster Medical System annual conference and many others).

The organization's mission and programs are supported by a comprehensive EM policy, established in 1999 (VA 1999). This guidance incorporates Comprehensive Emergency Management (CEM), the Integrated Emergency Management System (IEMS), the Incident Command System (ICS), and the program elements described in *NFPA 1600* as a means of helping to ensure continuity of patient care; to protect the safety of patients, visitors, and staff; and to reduce damages to property, equipment, and supplies.

EMERGENCY MANAGEMENT STANDARDS

The Joint Commission's EM Standard (EC 1.4)

The Joint Commission was founded in 1951 through a merger of five professional associations. Its mission is to continuously improve the safety and quality of care provided to the public through the provision of health care accreditation and related services that support performance improvement in health care organizations. In general, Joint Commission accreditation is mandatory for most US health care organizations.

EM is one of seven areas within the Environment of Care (EC) standards. The other areas are safety, life safety (fire), security, hazardous materials and wastes, utility systems, and medical devices. The goal of the EC standards is to provide a safe, functional, supportive, and effective environment for patients, staff members, and other individuals in the health care facility.

During 1999, EMSHG was invited to provide input to the Joint Commission's revision of its emergency preparedness standard. That input included advocating the use of CEM as an overall context, a hazards vulnerability analysis as the basis for a facility's program, and use of the ICS to promote inter-operability with community response agencies. These recommendations were reflected in the 2001 JCAHO EM standards.

NFPA 99, Chapter 11: Health Care Emergency Management

Pre-dating the Joint Commission's standard for emergency preparedness, *NFPA 99/11* has just completed its revision cycle. The 2001 version reflects the Joint Commission's adoption of CEM; its minimum criteria parallel *EC 1.4, NFPA 99/11*, and the explanatory material in its Appendices are a useful resource to health system planners.

NFPA 1600, Standard for Emergency Management and Business Continuity

Representing the consensus between public and private sectors, international, national, State, and community organizations, *NFPA 1600* provides a generically useful model for comprehensive emergency management programs. The program elements were drawn from the previously developed *Capability Assessment for Readiness* (CAR). *NFPA 1600* and CAR form the foundations of the Emergency Management Accreditation Program, which was based in part on the Joint Commission's accreditation process (NC 1997).

BUILDING A STANDARD PROGRAM DESCRIPTION

While the Joint Commission's new EM standard contains the right information to bring health care facilities more effectively into the mainstream with the community's program, a roadmap was needed to assist health system planners in complying with the intent of the standard. Specifically, health care facilities needed to learn how to adapt their focus from response to a program that addressed mitigation, preparedness, response, and recovery.

Since *NFPA 1600* provides a comprehensive outline for EM programs, it was used as the overall framework within which *EC 1.4* and then *NFPA 99/11* were located (see Diagram

Three). This model is referred to as the *Standard Program Description*. Two companion documents were then built from this: *Program Development Guidance*, the subject of the remainder of this article, and a *Program Review Tool* for use in mock Joint Commission accreditation surveys.

Planning Models

None of the standards mentioned above contain or refer to any step-by-step guidance on how to develop an EM program, even though IEMS has been in existence for over twenty years. A streamlined program development process was created by taking the outline of *NFPA 1600* and placing the elements within three program areas: Leadership and Direction, Mitigation and Recovery; and Preparedness and Response (see Diagram Four). The various tasks that support each program area were identified and organized sequentially to create a modified IEMS process (see Diagram Five).

Program Leadership and Direction. Establishing program leadership and direction consists of five tasks: designating the EM Coordinator and Committee and assigning each responsibilities, conducting a review of the current program, developing the program management plan, gaining executive support, and creating opportunities for regular inter-organizational coordination.

Developing the management plan to satisfy the intent of the Joint Commission's new standards (eg the four phases of EM) is a key area where emergency managers can assist health system planners. Also, linking health system planners with reference materials, training courses, and community exercises is an important opportunity for enhancing coordination.

Mitigation and Recovery. The four steps in this program area include: identifying critical operations and the human, physical, and informational resources on which they depend; performing a hazards vulnerability analysis; developing priorities and processes for the restoration of critical systems; and structural and non-structural mitigation efforts.

The health care industry took the Y2K crisis very seriously and as a result, most of the analyses in this program area have been completed. One exception may be the hazards vulnerability analysis (HVA). The Joint Commission is now requiring an HVA be conducted and the experience gained by emergency managers with this process should be shared with the area health care facilities.

Preparedness and Response. Being prepared to respond to disasters involves both knowledge and actions. Some of the important tasks in this program area include resource management (eg identifying multiple sources of critical resources and either purchasing or arranging for their purchase or loan); emergency operations planning; education, training, and exercises; and conducting evaluations and ensuring corrective actions are taken.

The disaster research provides a wealth of important knowledge, some of the most salient from Russell Dynes (1994) who suggests linking disaster relevant groups while maintaining their pre-existing authority and autonomy; establishing joint facilities and creating a process to collect and share information, set priorities, and make decisions; and conducting regular rehearsals to improve the ability to improvise and solve problems created during disasters.

The emergency operations or response plan should follow the format used by the *Federal Response Plan* (basic plan and functional annex format) in order to dovetail with the ICS. Too often, the "disaster plan" and ICS are regarded as separate parts when in fact they must be complementary.

Management Systems

Essential Functions and Key Activities. Diagram Six illustrates the structure of a model health care facility emergency management plan. Converting a departmentally-organized plan (eg nursing service, engineering service, and so forth) to a functionally-organized plan is made easier by listing the various activities performed in an emergency or disaster and then placing them under the appropriate management function (eg management and staff, operations, planning/intelligence, logistics, and finance/ administration). The State of California's *Standardized Emergency Management System* (1994) illustrated how to do this. Diagram Seven shows how, for example, the activities called for in EC 1.4 would be organized. VA used this approach in the development of what is referred to as the *Management Tool* (see Diagram Eight).

The *Management Tool* condenses Management and Planning into one "essential function," and Logistics, Finance/Administration into another. You will notice the key activities under these functions are in large part, the ICS units. Four functional groups were identified under the Operations section: Business Continuity, Plant and Utilities, Safety and Security, and Health and Medical. The key activities listed represent the generic tasks health care facilities may have to perform during disasters.

The *Management Tool* has been used in tabletop exercises to teach the dynamics of emergencies and the flexibility intended by modern emergency plans. As you will notice, the time frames along the top include a pre-impact period and underscore the importance of establishing operational periods post-impact. Only after audiences have gained an appreciation for the *Management Tool* is the *Management Structure* introduced (see Diagram Nine) and the ICS explained.

When teaching ICS, the eight components (Diagram Ten) are emphasized as these are critical to understanding and using the system, but are often overlooked. Another important point when teaching how ICS is used to implement the plan and manage an incident is based on the characteristics of the emergency itself, namely whether there is a warning period or not. If there is a warning period, Management "start" the plan using the Incident Action Planning (IAP) process (See Diagram Eleven). Most managers have been previously exposed to management by objectives, so they readily adapt to the IAP. If there is no warning, any employee can "start" the plan by what LaValla and Stoffel (1993) referred to as "thirteen probable steps." (See Diagram Twelve) (VA 1993).

SUMMARY

Because of the recent revisions to the three program standards discussed within, a bridge was built between the health care industry and the emergency management community that should reduce the "isolation" of the health and medical sector reported in the literature. Emergency managers should take this opportunity to reach out to health system planners and make them aware of the resources available in the greater EM community.

The usefulness of *NFPA 1600*'s framework has been demonstrated in this article. By combining the three standards, a common point of reference was created that is useful to health system planners and emergency managers. Organizing the program elements in sequential order yields a program development process that is currently missing. Attention to key activities generic to most disasters improves the ability of management and staff to understand the dynamics of disasters and the relationship between the response plan and the incident command (management) system. By adapting health care facility emergency operations plans to the functional annex format, it will be easier to learn how ICS is used to implement the plan. Finally, the joint planning called for by the Joint Commission will be enhanced now that mainstream EM concepts, plans and management systems are required.

Diagram One:
Emergency Management Best Practice "Top Ten"

(In chronological order)

1. Disaster Research (1960 - present)
Understanding how individuals, groups and organizations may behave.

2. Comprehensive Emergency Management (1979)
All hazards, four phases.

3. Integrated Emergency Management System (1980)
Implementation process, inclusive philosophy, orientation on functions.

4. National Interagency Incident Management System (NIIMS), Incident Command System (1981)
NIIMS: ICS, training, qualifications/certification, supporting technologies and publications.
ICS: 8 components, 5 management functions.

5. Federal Response Plan (1992)
Example all hazard plan; incorporation of ICS.

6. Standardized Emergency Management System (1994)
Five response levels; built on ICS management functions, focused on EOCs

7. Capability Assessment for Readiness (1997)
Pioneer evaluation tool for the self-assessment of the capacity to perform EM.

8. NFPA 1600, Standard for Emergency Management and Business Continuity (2000)
Generic EM program description; public and private sector consensus.

9. Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Emergency Management Standard (2001) and NFPA 99/11 (2001)
Critical aspects for health systems, adopts CEM and ICS.

10. Emergency Management Accreditation Program (2001)
Objective assessment of organization's capacity to perform EM.

Diagram Two:

Joint Commission Emergency Management Standard

Standard EC.1.4, A Plan Addresses Emergency Management.

Intent of EC.1.4 The emergency management plan describes how the organization will establish and maintain a program to ensure effective response to disasters or emergencies affecting the environment of care. The plan should address four phases of emergency management activities: mitigation, preparedness, response, and recovery .

The plan provides processes for:

a. identifying specific procedures in response to a variety of disasters based on a hazard vulnerability analysis performed by the organization;

b. initiating the plan (including a description of how, when, and by whom the plan is activated);

c. defining, and when appropriate, integrating the organization's role with community-wide emergency response agencies (including the identification of who is in charge of what activities and when they are in charge) to promote inter-operability between the health care organization and the community;

d. notifying external authorities of emergencies;

e. notifying personnel when emergency response measures are initiated;

f. identifying personnel during emergencies;

g. assigning available personnel in emergencies to cover all necessary staff positions;

h. managing the following during emergencies and disasters:

- Patients' activities including scheduling. modifying, or discontinuing services, control of patient information, and patient transportation;
- Staff activities (for example housing, transportation, and incident stress debriefing);
- Staff-family support activities;
- Logistics of critical supplies (for example pharmaceuticals, medical supplies, food supplies, linen supplies, water supplies);
- Security (for example access, crowd control, traffic control); or
- Interaction with the news media;

i. evacuating the entire facility (both horizontally and, when applicable, vertically) when the environment cannot support adequate patient care and treatment;

j. establishing an alternative care site(s) that has the capabilities to meet the clinical needs of patients when the environment cannot support adequate patient care including processes that address (when appropriate):

- Management of patient necessities (for example medications and medical records) to and from the alternative care site,
- Patient tracking to and from the alternative care site,
- Interfacility communication between the organization and the alternative care site, or
- Transportation of patients, staff, and equipment to the alternative care site, and

k. continuing and/or re-establishing operations following a disaster.

The plan identifies:

l. an alternative means of meeting essential building utility needs (for example, electricity, water, ventilation, fuel sources, and medical gas/vacuum systems) when the organization is designated by its emergency plan to provide continuous service during a disaster or emergency;

m. backup internal and external communication systems in the event of failure during disasters and emergencies;

n. facilities for radioactive or chemical isolation and decontamination; and

o. alternate roles and responsibilities of personnel during emergencies, including who they report to within a command structure that is consistent with that used by the local community.

Diagram Three:
Joint Commission EC 1.4 set within NFPA 1600

NFPA 1600	EC 1.4
Chapter 1. Introduction	
Scope	
Purpose	
Chapter 2. Program Management	
Policy	
Program Coordinator	
Program Committee	
Program Assessment	q
Chapter 3. Program Elements	
General	Intent
Laws and Authorities	
Hazard Identification & Risk Assessment	a
Hazard Management	
Resource Management	
Planning	g, k
Direction, Control & Coordination	b, c, f, o
Communications & Warning	d, e, m
Operations & Procedures	a, h
Logistics & Facilities	h, I, n
Training	p
Exercises, Evaluations & Corrective Actions	r
Public Education & Information	h
Finance & Administration	

Diagram Four:
NFPA 1600 Elements Set Within Three Program Areas

Program Areas	NFPA 1600 Elements
Leadership and Direction	Scope
	Purpose
	Policy
	EM Program Coordinator
	EM Program Committee
	Program Assessment
	General
	Laws & Authorities
	Resource Management
	Planning (Strategic Administrative Plan)
Mitigation/Recovery	Hazard Identification & Risk Assessment
	Planning (Recovery and Mitigation)
	Operations & Procedures
	Hazard Management
Preparedness/Response	Resource Management
	Planning (Emergency Operations/Response)
	Direction, Control & Coordination
	Communications and Warning
	Operations and Procedures
	Logistics & Facilities
	Training
	Exercises, Evaluations and Corrective Actions
	Public Education and Information
	Finance & Administration

Diagram Five
Program Development Process

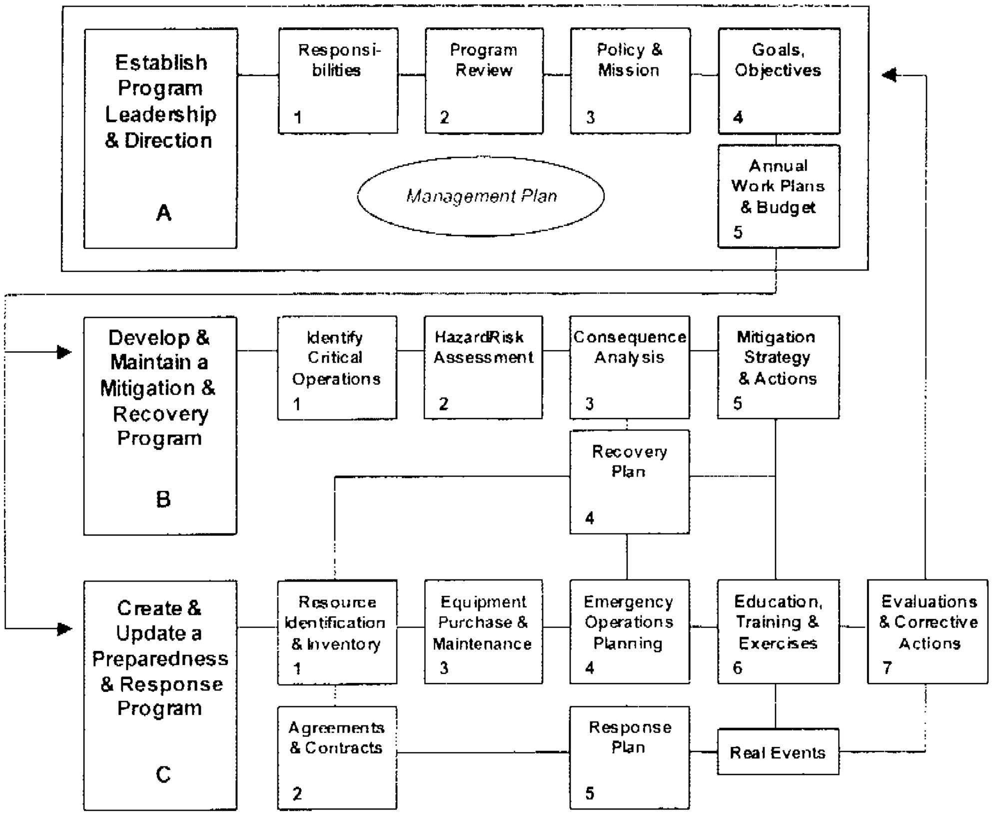

Diagram Six: Sample Health Care Facility Response Plan Structure

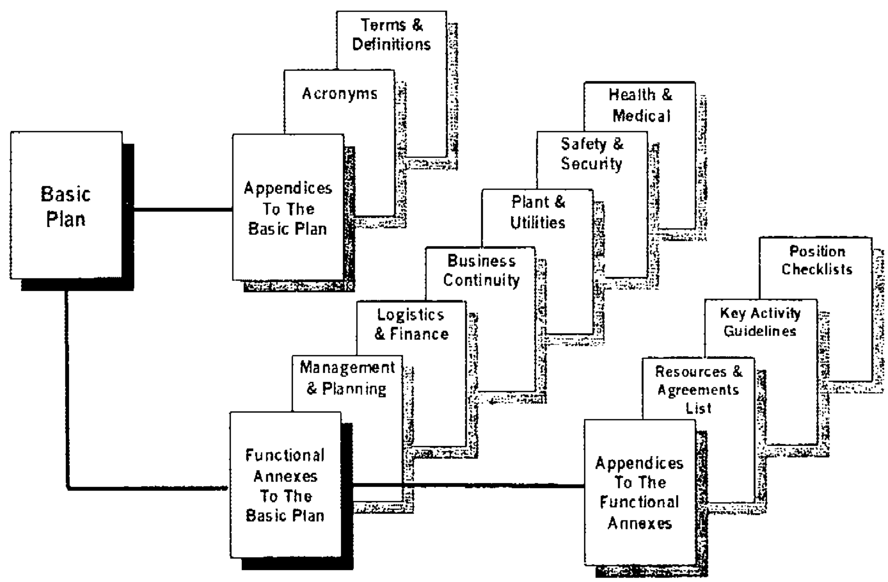

Diagram Seven
Aligning EC 1.4 Set within the SEMS/ICS Functions

Joint Commission EC 1.4 Requirements	Standardized Emergency Management System/ICS Functions				
	Management and Staff	Operations	Planning / Intelligence	Logistics	Finance / Administration
Alerting & Warning		○			
Scheduling of Services			○		
Patient Information	○				
Staff-Family Support				○	
Stress Debriefing - Staff				○	
Critical Supplies				○	
Security		○			
Media Relations	○				
Alternative Care Site(s)				◍	
Evacuation of Patients		○			
Interfacility Coordination	◍				
Patient Transportation				○	
Patient Tracking			○		
Business Resumption		○			
Utility Systems				○	
Communications Systems				○	
Decontamination		○			

Diagram Eight:
Management Tool

Situation: ______________

ESSENTIAL FUNCTIONS	*KEY ACTIVITIES*	BEFORE	0:00-4:00	4:00-8:00	8:00-12:00	12:00-24:00	24:00-48:00
MANAGEMENT & PLANNING/ INTELLIGENCE FUNCTIONS	EMERGENCY POLICIES						
	LIAISON						
	PUBLIC INFORMATION						
	SAFETY						
	INCIDENT ACTION PLANNING						
	SITUATION STATUS						
	RESOURCE STATUS						
	DOCUMENTATION						
	DEMOBILIZATION						
LOGISTICS & FINANCE/ ADMINISTRATION FUNCTIONS	SUPPLY						
	FACILITIES						
	GROUND SUPPORT						
	COMMUNICATIONS						
	FOOD						
	MEDICAL						
	TIME						
	PROCUREMENT						
	COMPENSATION/CLAIMS						
	COST						
OPERATIONS FUNCTIONS							
BUSINESS CONTINUITY	ACCESS TO SERVICES						
	RECORDS PRESERVATION						
	BUSINESS RESUMPTION						
PLANT & UTILITIES	TELECOM / INFO MGMT SYSTEMS						
	MEDICAL DEVICES						
	MEDICAL GAS SYSTEMS						
	POWER/LIGHT SYSTEMS						
	HEATING/COOLING SYSTEMS						
	WATER/SEWER SYSTEMS						
	BUILDINGS/GROUNDS/ROADS						
SAFETY & SECURITY	ALERTING/WARNING						
	HAZMAT CONTROL						
	FIRE SUPPRESSION						
	SEARCH & RESCUE						
	SECURITY						
HEALTH & MEDICAL	TRIAGE						
	DECONTAMINATION						
	PATIENT CARE						
	PATIENT RELOCATION						
	OUTREACH						
	MENTAL HEALTH						
	FATALITIES MANAGEMENT						

Department of Veterans Affairs

Diagram Nine:
Management Structure

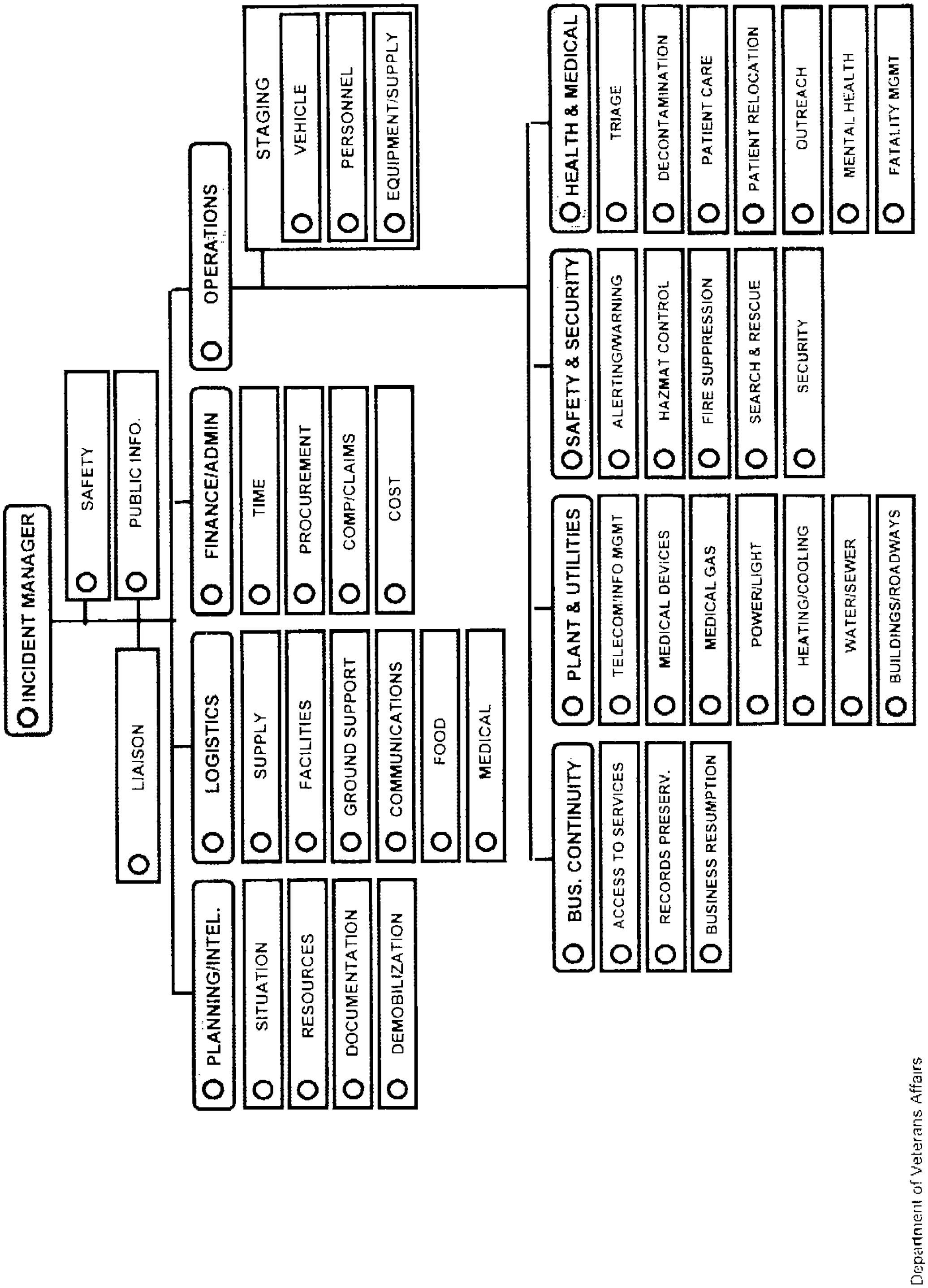

Diagram Ten:
Eight Components of ICS

1. Common Terminology
2. Modular Organization
3. Integrated Communications
4. Unified Command Structure
5. Consolidated Action Plans
6. Manageable Span-of-control
7. Predesignated Incident Facilities
8. Comprehensive Resource Management

Diagram Eleven:
Incident Action Planning (IAP) Process

Brief on Current Situation and Resource Status
Set Incident Objectives
Determine Areas of Operation
Specify Tactics for Each Group
Specify Resources Needed by Each Group
Specify Operating Facilities and Reporting Locations
Consider Communications, Medical, Safety and Traffic Requirements
Finalize, Approve, and Implement

Diagram Twelve:
"Thirteen Possible Steps"

Someone takes charge!
Size-up
Establish a Command Post
Establish Communications
Develop an Initial Attack Strategy
Resource Analysis
Designate an Operations Chief
Designate a Safety Officer
Secure the Scene
Deploy Responders
Designate a Planning Chief
Designate Other Functions as Needed
Continue to Organize and Manage!

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FLORIDA'S HISTORICAL DEVELOPMENT, ITS VULNERABILITY TO HAZARDS, AND THE CREATION OF A LEADING STATE EMERGENCY MANAGEMENT SYSTEM

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Florida's emergency management structure has been shaped by the particular risks related to its unique geographical location, as well as its historical patterns of settlement and development. This article discusses the institutionalization of Florida's emergency management system, one of the leading programs in the nation. We examine the development of emergency management in the state in relation to its hazard vulnerabilities and disasters and include a variety of organizational, legislative, and operational initiatives that forged the current state of the Florida Division of Emergency Management.

RELEVANT STATE CHARACTERISTICS

Florida's modern history has been driven by demographic change. When admitted to the union in 1845, Florida's population was only 69,000 residents. Fifty years ago there were fewer than 2 million residents, and the state ranked 27th in population (Dye 1998). By contrast, the 2000 census placed Florida as the fourth most populous state, home to approximately 15,982,378 (US Bureau of the Census 2000). Current data exceeds the estimates released by the Bureau of Economic and Business Research in 1999. Throughout this century, Florida's growth has greatly exceeded that of the nation as a whole, usually being two, three, or four times higher, depending on the time period. Florida's population nearly doubled each decade from the 1950s through the 1980s (DeGrove and Turner 1998). More than 1.2 million people moved into the state between 1990 and 1995 (Dye 1998). The state's population grew 23.5 percent between 1990 when the census estimated a population of 12.9 million and 2000. While expansion is more rapid than the nation as a whole (13.2 percent), it is not nearly as strong as Florida's growth rate in the 1970s (43.0 percent) and 1980s (32.8 percent). By 2025, the United States Bureau of the Census (1998) projects Florida will surpass New York to become the third most populous state in the nation, with 20.7 million people.

Florida's exploding growth has historically stemmed almost entirely from waves of new residents from elsewhere in the US. Thousands of Southerners, black and white, rushed to the promising frontiers of Florida during the Civil War reconstruction, during the 1920s boom, and during the flush times associated with World War II (Mohl and Mormino 1996). Fully 70 percent of the current population originated from outside of the state: New Yorkers constitute the largest number of new residents, followed by people from New Jersey, Massachusetts, and Pennsylvania (Dye 1998).

The aging of Florida has become one of the state's most pronounced social trends. Retirement to Florida from the Midwest and Northeast was an important trend during the 1940s and 1950s. Tens of thousands of Jews from the Northeast retired to Miami and Miami Beach, and Midwesterners similarly retired to the St Petersburg area (Mohl and Mormino 1996). Florida's population has been aging faster than that of any other state. In 1880, the median age of Floridians was 18, one of the nation's lowest; by 2000 the state's median age was 38.7, the nation's highest (Mohl and Mormino 1996, US Bureau of the Census 2000). By 1995 Florida had the highest percentage of population aged 65 and older in the nation (18.57%) and had the second lowest percentage of school-aged population in the nation (17.0%) (US Department of Education 1996, US Bureau of the Census 1996).

In recent years Florida's growth has been tied to immigration from outside of the country. From the beginning of the Cuban refugee exodus in 1959 until the 1990s, close to one million Cuban exiles have immigrated to Florida (Dye 1998). The Cubans were followed by massive migrations of Haitians and Nicaraguans and smaller contingents from virtually every Caribbean and Latin American nation. In Miami, more than 53 percent of the people now speak a language other than English at home (Mohl and Mormino 1996).

Such tremendous population growth went hand in hand with infrastructure development. Beginning in 1880, a great surge in railroad construction opened up new areas for settlement, tourism, and economic development (Mohl and Mormino 1996). The building of highways and roads to serve the automobile also accelerated the development of Florida. Historically, American cities evolved by developing commerce, industry, and transportation, but Florida cities such as Daytona Beach, St Petersburg, and Miami Beach sold themselves as tourist destinations, promoting beaches, salt air, endless sunshine, and the Florida dream (Mohl and Mormino 1996). By 1933 an estimated one million tourists a year were arriving in Florida. By 1940, they numbered 2.8 million, and that number increased exponentially to 5 million in 1950, 20 million in 1980, and 40 million in 1990. Disney World opened in 1971 and by the 1980s had become the world's greatest tourist attraction with over 20 million tourists a year. According to Mohl and Mormino (1996), by 1994 Disney World totaled one billion tourists a year. By the mid-1990s, tourism became a $32 billion industry-truly, the bedrock of Florida's economy (Mohl and Mormino 1996).

With continued population growth and development has come speedy urbanization. As of 1990, just over 84 percent of Floridians lived in urban areas, a figure unchanged from 1980 despite 32.8 percent population growth statewide (DeGrove and Turner 1998). During the 1980s, ten of America's 20 fastest growing metropolitan areas were found in Florida (Mohl and Mormino 1996). Florida had four metro areas that grew by more than 500 percent between 1940 and 1990: the Sarasota-Bradenton area grew by 1,060 percent; West Palm Beach grew by 980 percent; the Miami-Fort Lauderdale metropolitan area grew by 938 percent; and the Tampa-St. Petersburg area grew by 609 percent (Thomas

1995). In particular, Florida's coastal urban population has expanded from fewer than 7.7 million in 1980 to over 10.5 million by the mid-1990s, an increase of 37 percent (Lecomte and Gahagan 1998). According to the Florida Department of Community Affairs (1999), more than nine million Floridians lived within 10 miles of the coast in 1998, more than 62 percent of the state's total population.

As a result of Florida's settlement and development patterns, the state has experienced increasing social complexity. Rapid population growth coupled with high urban migration has made Florida a developer's dream. The population dynamics and demographic changes interact with the state's natural and technological hazards, however, resulting in unique risks and vulnerabilities. For example, dense urban development along the Atlantic and Gulf coasts has destroyed much of the natural coastal buffer areas, leaving millions of residents more vulnerable to hurricanes.

FLORIDA'S VULNERABILITY TO HURRICANE HAZARD

Florida is the state geographically and historically most vulnerable to hurricanes. Between 1900 and 1997 Florida was hit directly by more than one-third of the hurricanes that struck the United States (57 of 159), which is far more than that experienced by any other Atlantic or Gulf Coast state (Lecomte and Gahagan 1998). Furthermore, according to the National Hurricane Center (1999), Florida has experienced five of the six most intense hurricanes to make landfall in the US this century. Four were estimated to be Category 4: the hurricane of 1919 impacting the Florida Keys; the 1928 hurricane that overflowed Lake Okeechobee; Hurricane Donna in 1965; and Hurricane Andrew in 1992. The 1935 Florida Keys hurricane is believed to have reached Category 5.

Due to the state's coastal population density, there are more people at risk in Florida from hurricane hazard than in any other state in the nation (IIPLR and IRC 1995). Florida also has the most coastal property exposed to wind storms in the country. According to Lecomte and Gahagan (1998), five of the 10 most costly hurricanes in terms of insured losses have occurred in Florida: Hurricane Andrew in 1992 caused $15.5 billion in losses, Hurricane Opal in 1995 caused $2.1 billion in losses, Hurricane Frederic in 1979 caused $750 million in losses, Hurricane Elena in 1985 caused $540 million in losses, and Hurricane Betsy in 1965 caused $515 million in losses. From 1980 to 1993, the value of Florida's insured residential and commercial property increased by 162 percent from $333 billion to $872 billion while the insured residential and commercial property for the entire US coastal area increased by 179 percent (IIPLR and IRC 1995). According to the Insurance Services Office (2000), Florida had the most insured losses in the country in the period from 1990 to 1999 with $19.3 billion. California was second with $17.5 billion and Texas was third with $6.6 billion in insured losses.

It is clear then that entire communities can be impacted by the effects of a hurricane in loss of life or injury and loss of homes and businesses that affect individual and family quality of life. Even those not directly impacted by the death of a loved one, injury, or damage to their homes or place of employment are indirectly affected if the normal functioning of the community is disrupted. According to Peacock, Gladwin, and Morrow

(1997), residents who did not experience direct damage or injury from Hurricane Andrew still considered themselves "Andrew victims" because of the heavy damage to the physical and social infrastructure of the community.

OTHER HAZARDS THAT AFFECT FLORIDA

While hurricanes are an obvious and serious threat to the citizens of Florida, the state also faces a number of other natural hazards and disaster risks in the form of wildland fires, drought/flooding, tornadoes, and technological disasters such as hazardous materials spills. In fact, Florida is ranked as one of the three most hazardous states in the nation along with Texas and California based on frequency of events, deaths, injuries, and damage over the 1975 to 1994 period (Mileti 1999).

Florida is home to millions of residents who enjoy the state's beautiful scenery and warm climate. But few people realize that these qualities also create severe wildfire conditions. Florida is one of the states most at risk for wildland fires due to its wooded, brushy, and grassy areas (Florida Division of Emergency Management 1999). Each year, thousands of acres of wildland and many homes are destroyed by fires that can erupt at any time of the year from a variety of causes, including arson, lightning, and debris burning (Florida Division of Emergency Management 1999). Adding to the fire hazard is the growing number of people living in new communities built in areas that were once wildland. As residential areas expand into relatively untouched wildlands, forest fires increasingly threaten people living in these communities. For example, in May 1998 Florida entered into a major drought, which caused intense wildland fires. The fires burned for two months causing evacuations, road closures, and property damage. Ultimately, more than 2000 fires burned nearly 500,000 acres of federal, state, and private lands, and more than 110,000 people were evacuated including all of Flagler County (Florida Department of Community Affairs, Florida DCA hereafter, 1999).

Tornadoes are another risk that affects the state. Tornadoes sometimes accompany hurricanes such as the tornado outbreaks across Florida associated with Hurricane Georges in 1998 (Florida DCA 1999). Exclusive of hurricanes, the state is among the most tornado-prone states. According to the Insurance Information Institute (1999), Florida is third in reported tornados with 2,394 during the period from 1950 to 1998. Florida is the top ranking state in terms of annual tornadoes per 10,000 square miles (The Tornado Project 2000). The severe weather that swept across Central Florida in February 1998 spawned the deadliest round of tornadoes on record. Forty-two people were killed and more than 250 were injured over a nine-county area (Wilson and Oyola-Yemaiel 1998).

Another risk that Florida faces periodically is freezing temperatures. Because Florida sustains a warm climate most of the year, it is considered a tropical paradise by tourists as well as home to the multi-billion dollar fresh-market vegetable, sugarcane, and citrus industries. Florida produces about 40% of the commercially grown fresh tomatoes in the United States. Florida also produces about 51% of the commercially grown eggplant in the United States. Both tomatoes and eggplant are adversely affected by exposure to low temperatures (Maynard 1995). Severe freezes in Florida can threaten the economic well-being and the citizens of the state. For example, in the winters of 1983 and 1985 severe freezing weather to central and northern Florida caused no deaths but caused over $2 billion and $3.5 billion respectively worth of damage to the citrus industry (National Oceanographic and Atmospheric Agency 2000). Freezes severely damaged Florida sugarcane on four occasions during the last 25 years: January 1977, January 1981, January 1982, and December of 1989 (Tai and Lentini 1998). During the harsh winter of 1989 to 1990, 26 Floridians died of hypothermia, and the state was granted a presidentially declared disaster due to freezing conditions.

A more severe drought/flooding cycle has begun due to human intervention in the freshwater supply in the natural system of the Everglades (Oyola-Yemaiel 1999). The natural Everglades wetland is the equalizer of these cycles but human management of this system has exacerbated the natural drought/flood cycle of this ecosystem. Since the early 1900s, a variety of local, state, and national laws and regulations had encouraged the draining, filling, channelling, and damming of the Florida Everglades. What is left of the Everglades supports a number of important ecosystems and purifies south Florida's drinking water. Human encroachment in the form of urbanization into the Everglades has become an increasingly important problem, as flood protection and the area's freshwater supply depend on the health of the Everglades (Oyola-Yemaiel 1999).

Flooding is a major hazard in Florida. For example, in October 1997 severe weather with heavy rains and strong thunderstorms resulted in flash floods in the central and south-central parts of the state (Florida DCA 1999). Heavy rainfall in the same areas over the previous two-week period contributed to the flash flooding. Throughout the winter of 1997 and spring of 1998 record flooding associated with El Niño occurred across the state (Florida DCA 1999).

Florida also faces significant technological hazards in the form of hazardous material spills, radiological leaks, train derailments, and air crashes, among others. For example, in 1997 the University of Florida in Gainesville initiated a disposal operation for an extremely hazardous experimental rocket fuel that was developed by the US military more than 20 years ago and stored at the university (Florida DCA 1999). Later that year 34 cars of a 74-car freight train derailed spilling hazardous materials such as hydrogen peroxide and sulfuric acid in Jackson County. Also in 1997, a cargo aircraft crashed upon take off in a business district just outside of Miami International Airport. According to the Florida Department of Community Affairs (1999), hazardous materials incidents are the second highest reported emergencies in Florida following severe weather emergencies. Search and rescue incidents are third, aircraft incidents are fourth, and transportation incidents are the fifth most reported emergencies in Florida.

According to the US Environmental Protection Agency (1997), Florida ranks 10th in the nation in toxic releases, with 519 facilities listed. Florida has 23 brownfield sites (Florida Department of Environmental Protection 1999a), 95 active landfills (Florida Department of Environmental Protection 1999b), and 67 Superfund sites (US Environmental Protection Agency 2000). In addition, Florida maintains six nuclear power plants that are at risk of storm surge because they are all located at sea level in coastal areas. Florida

Power and Light Company's Turkey Point nuclear power plant was directly in Hurricane Andrew's path. Consequently, one of the stacks cracked and had to be demolished resulting in $100 million of damage (Florida Power and Light 1994).

Thus, Florida faces a number of natural and technological hazards. These risks coupled with rapid population growth, urbanization, and development have resulted in increasing levels of vulnerability. Such vulnerability has given rise to and fostered the institutionalization of a contemporary emergency management system.

FORMULATING THE EMERGENCY MANAGEMENT SYSTEM IN FLORIDA

The risks and vulnerabilities that Florida faces are being addressed through new coordination efforts that follow FEMA's guidelines for Comprehensive Emergency Management. In 1981, the Florida Department of Community Affairs recommended that the state adopt the Comprehensive Emergency Management model (Florida DCA 1999). The final recommendation of the Department of Community Affairs was a proposed state hazard mitigation program to be managed by the Bureau of Disaster Preparedness (now the Division of Emergency Management) within the Department of Community Affairs (Mittler 1997). The Division of Emergency Management was placed within the Department of Community Affairs in order for the state to maintain a close working relationship between emergency management and community planning, zoning, and housing issues.

Shortly thereafter, in 1983, the Florida House of Representatives formed a Select Committee on Growth Management to survey Florida's coastal zone management program to plan for the orderly development of the coast while protecting the state's natural coastal resources. The Select Committee on Growth Management (Florida House of Representatives 1983) concluded in part that the state needed to improve hazard mitigation in coastal construction and development practices. Additionally, in 1986 the Florida Coastal Resources Citizens Advisory Committee, under the auspices of the Office of Coastal Management in the Department of Environmental Regulation, evaluated Florida's coastal management policies and programs and offered several recommendations for executive and legislative action. Like the previous study, this committee warned that current construction and design practices were "inadequate to protect lives, property and natural resources in the event of major hurricanes and in recognition of long-term shoreline erosion" (Florida Coastal Resources Citizens Advisory Committee 1986:2).

In view of these studies, in July 1989, the Speaker of the Florida House of Representatives "appointed a Task Force on Emergency Preparedness to review the current system of emergency management in Florida" (Florida House of Representatives 1990b:iii). The task force was made up of emergency management experts from throughout Florida working under the auspices of the House Committee on Emergency Preparedness, Military, and Veteran Affairs.

The objectives of the task force were:

1. To address the need to revise the state's current system of emergency management.

2. To identify barriers which impact the current system's ability to respond to emergency situations.

3. To evaluate the current organizational structure of emergency management at the state and local levels.

4. To review existing funding mechanisms related to the emergency management system.

5. To identify strategies for increasing the involvement of the private sector and enhancing coordination between agencies relevant to this sector (Florida House of Representatives 1990b:iii).

In order to meet the objectives, the task force operated as four distinct subcommittees: 1) Evacuation and Sheltering, 2) Communications, Operations, and Coordination, 3) Funding, and 4) Public Awareness and Education. Each subcommittee was tasked to develop recommendations that could serve as the basis for a comprehensive committee bill submitted in the 1990 regular legislative session (Florida House of Representatives 1990b). The subcommittees report included a detailed set of prescriptions needed by the state to overcome existing weaknesses and to provide the state with an adequate coordinated response to emergency situations (Florida House of Representatives 1990b).

Key findings included:

1. There were insufficient shelter spaces for potential evacuees from coastal storms;

2. The population contained a large number of people with special needs, especially the elderly and the infirm in hospitals, mass residential facilities, and chronic care facilities;

3. Potential shelters, schools and churches, were not suitably equipped or designed to act as emergency shelters;

4. The state lacked coordinated communications and plans, especially between state agencies and between state agencies and local governments;

5. Many cities and counties had not established or maintained an emergency management agency;

6. State funding for emergency management was inadequate; only $2.1 million of the Division of Emergency Management's budget for fiscal year 1989-1990 of a total of

$11.4 million came from general revenue; the remainder was provided from federal sources; therefore, the state needed a dedicated source of funds to guarantee any enhancement of state and local services since it could not rely on general revenues which were budgeted at $1.9 million in the next fiscal year; and

7. A state educational effort was needed because the public was ill informed concerning how to prepare for, respond to, and mitigate disasters (Florida House of Representatives 1990b).

Key recommendations addressed:

1. Development of hurricane evacuation plans including plans for the special needs population and the coordination of road construction so as to avoid blockage of evacuation routes during the hurricane season;

2. Development of a comprehensive sheltering system with funding provided for the acquisition and construction of shelters;

3. Identification of refuges of last resort which would be available for those unable to reach evacuation shelters;

4. Revision of building codes to require hurricane shutters on multi-unit housing;

5. Continued development of a statewide communications system including the development of local networks;

6. The requirement that each county establish and maintain an emergency management agency and create a county emergency management plan;

7. Strengthening coordination of federal, state, and local emergency management operations through enhanced planning required by state statute and funds provided by the state to assist local efforts;

8. Establishment of a state Disaster Preparedness Trust Fund administered by the Department of Community Affairs to supplement federal funds in order to provide a grant program for the development of state services and local emergency preparedness, response, and relief;

9. Funding the Trust Fund by either fees for transactions or activities in high-risk or vulnerable areas, an increase in the DOC stamp tax, an increase in the gasoline tax, a surcharge on 18-wheelers, an assessment on mobile homes, or a surcharge on homeowner's property insurance policies; and creation and funding statutorily of a comprehensive public awareness and education program (Florida House of Representatives 1990b).

The House Committee on Emergency Preparedness, Military, and Veterans Affairs introduced a bill in 1990 to overhaul the emergency management system in Florida (Florida House of Representatives 1990a). In general, it revised the duties and responsibilities of the Division of Emergency Management, giving it greater control to plan and coordinate a statewide system of emergency management. It mandated that each county establish and maintain an emergency management agency, appoint a director, and develop a county emergency plan in support of the state comprehensive emergency management plan. Most importantly, it created the Emergency Management Assistance Trust Fund which would be funded by an annual $2 per policy surcharge on every homeowner's and $4 per policy surcharge on every commercial property insurance policy (Mittler 1997, Florida House of Representatives 1990a).

According to Mittler (1997), this bill passed in the House but the Senate Committee on Finance and Taxation opposed it with the acknowledged stumbling point being the creation of the trust fund. It was also believed by many in the Senate that hurricanes were a south Florida concern and should not be subsidized by property owners in other parts of the state. The insurance industry also opposed the bill because a surcharge was considered a bad precedent and it did not want private insurance rates to include what amounted to public taxes (Mittler 1997). Again, in both 1991 and 1992 the House Committee on Emergency Preparedness, Military, and Veterans Affairs introduced similar House bills. Neither bill was able to gain legislative approval (Mittler 1997).

THE EXPERIENCE OF HURRICANE ANDREW

As Hurricane Andrew was approaching Florida and the advance element of the federal emergency response team was deployed to the state emergency operations center in Tallahassee, it was evident that the state lacked sufficient space and resources to coordinate an operation to handle a disaster caused by a major hurricane (FEMA 1993). The existing federal response plan relied on the state to initiate requests for federal assistance after the President declared a major disaster, however, the state was not capable of providing adequate assessments of its damage and was unprepared to make appropriate requests for assistance. In a post-disaster audit of FEMA's disaster management performance after Hurricane Andrew, the Inspector General of FEMA (1993:41) noted that state officials acknowledged that their initial assessment of requirements for federal assistance were too low, and that at first they were resistant to the idea of a massive flood of Federal resources into south Florida. Other problems noted by the Inspector General included a failure on the part of the state to request certain federal services because the state was reluctant to incur its 25% cost share and the lack of awareness of certain services by both state and local officials (FEMA 1993).

What became evident in the first weeks after Andrew was that FEMA and the overall federal response, as well as the Florida response, were uncoordinated, confused, and often inadequate (FEMA 1993). Governor Chiles issued an executive order establishing the Governor's Disaster Planning and Response Review Committee headed by Gerald Lewis "to evaluate current state and local statutes, plans and programs for natural and man-made disasters, and to make recommendations to the Governor and the State

Legislature" no later than January 15, 1993 (Governor's Disaster Planning and Response Review Committee 1993).

The Lewis Committee met eight times between October and December 1992, received oral testimony from over 45 persons, took written testimony and recommendations from over 100 persons and organizations, and from this information developed 94 specific recommendations which were delivered in its final report (Governor's Disaster Planning and Response Review Committee 1993). It specifically examined "preparedness before Hurricane Andrew and response and recovery efforts during the first two weeks after landfall" so that it might isolate problems and suggest remedies whose implementation would "give Florida one of the best emergency management systems in the United States" (Governor's Disaster Planning and Response Review Committee 1993:i).

According to Mittler (1997), the Lewis Committee promoted the implementation of four key solutions:

1. Improved communications at, and among, all levels of government;
2. Strengthened plans for evacuation, shelter, and post-disaster response and recovery;
3. Enhanced intergovernmental coordination; and
4. Improved training

In addition, the committee appealed for increased funding for emergency preparedness and recovery programs, proposing that the legislature establish an Emergency Management Preparedness and Assistance Trust Fund and a dedicated funding source (surcharges on property insurance policies) similar to what had earlier been proposed (Governor's Disaster Planning and Response Review Committee 1993).

Because the state had just experienced a major disaster and those on the Lewis Committee and its technical advisory committee had first-hand knowledge of the state's emergency management strengths and weaknesses, its recommendations were an expanded list of the recommendations first offered by the Speaker's Task Force in 1990 but increased and refined to take into account actual experiences and technical advances since 1990 (Mittler 1997). The goal was an enhanced Division of Emergency Management, with an explicit chain of command, a knowledgeable public, and sufficient plans developed for evacuation and shelter. There would also be communications systems linking federal, state, and local governments and agencies, refuges of last resort, mandatory county plans for post-disaster response and recovery, and a training program for state and local officials and emergency personnel. There would be a new the capability for working with the federal government and coordinating post-disaster programs including the collection of timely damage assessment data, the coordination of medical services, enhanced security, and effective volunteer coordination. Finally, there would be sufficient funds to meet the present and future state emergency management needs (Mittler 1997).

The House Committee on Community Affairs and south Florida representatives introduced House Bill No 911 to implement the recommendations of the Lewis Committee in 1993 (Florida House of Representatives 1993). The House passed the bill virtually intact (Mittler 1997). When it was sent to the Senate, Senators from the central and northern parts of the state opposed inclusion of the funding mechanism, but before the Senate could take a final vote, several counties in the central and northern parts of the state were hit by a fierce winter storm on March 13, 1993, which convinced Senators in those areas that hurricane threats and emergency management were not just south Florida concerns (Mittler 1997). By April 1, both bills were overwhelmingly approved and sent to the House for ratification (Florida House of Representatives 1993). The Senate versions of both bills were approved by the House on April 2, 1993 and later signed by the Governor.

Mittler (1997) claims that positive legislative action in 1993 was the result of many factors, including:

1. The existence of a widely recognized problem that the emergency management system was inadequate to serve the needs of the state in the event of major natural and other disaster;

2. The support of the governor, many legislators, and the emergency management professionals in the state for comprehensive change and a dedicated source of funding;

3. The long-term development of a program of change which had fostered previous legislation, thereby establishing a foundation for the drafting of a new bill;

4. The use of a funding mechanism which did not increase taxes or divert general revenue funds from other programs; and

5. The occurrence of the winter storm of 1993 in the northern and central part of the state which convinced senators who had previously opposed the legislation that improved emergency management was a state and not just a south Florida issue (Mittler 1997).

Overall, however, the important reason was the realization by local and state officials, including the legislature that the emergency management system as it was at the time of Hurricane Andrew was inadequate. Thus it needed reorganization as well as structural mechanisms being put in place to increase statewide emergency management efficiency and effectiveness.

THE EMERGENCY MANAGEMENT PREPAREDNESS AND ASSISTANCE TRUST FUND

The 1993 Florida legislature acted on most of the Lewis Committee report's recommendations, including its call for the creation of the Emergency Management Preparedness and Assistance Trust Fund. The sole purpose of the Emergency Management Preparedness and Assistance Trust Fund was to "enhance local and state emergency management capabilities" so mistakes made during the Hurricane Andrew response and recovery operations would not be repeated (Koutnik 1996). This legislation has been touted as one of the most progressive pieces of emergency management legislation to ever be enacted, and has become the basis for the FEMA document, Model State Emergency Management Trust Fund Legislation (FEMA 1995).

The Emergency Management Preparedness and Assistance Trust Fund was created through a $2 surcharge levied on all private insurance policies, and a $4 surcharge on commercial policies. This produced more than $12 million in revenue in 1994 and more than $13 million in 1995. Insurance companies collect the funds and send the money to the Florida Department of Revenue to be credited to the trust fund (Koutnik 1996).

The legislature allocated the funds in the following manner: 12 percent for the state Division of Emergency Management; 40.8 percent for county emergency management organizations; 7.2 percent for municipalities; and 20 percent for competitive grants (Koutnik 1996). The remaining 20 percent was set aside for disasters that are not large enough to warrant a presidential disaster declaration, yet are of sufficient magnitude that they impact local communities in a significant manner (Koutnik 1999).

Realizing the importance of a strong state emergency management agency, the legislature gave Florida Division of Emergency Management 12 percent of the funds for improvements. In the first two years (1994-1996), the Division of Emergency Management secured state-of-the-art geographic information systems, a statewide satellite communications system, new staff members, and other equipment and resources (Koutnik 1996).

According to Koutnik (1996), while the state agency clearly benefits from the Emergency Management Preparedness and Assistance Trust Fund, most of the funds are returned to local and municipal governments. Every full-time county emergency management agency receives in excess of $100,000 as an annual, recurring base grant. This money does not supplant existing local funds (Koutnik 1999). The municipal funds are awarded on a competitive basis for projects consistent with a county emergency management organization. Twenty percent of the funds are set aside for another competitive grant program that allows any government or non-profit entity to apply for projects that enhance local or state emergency management capabilities (Koutnik 1996).

FLORIDA'S EMERGENCY MANAGEMENT ACT

The specific powers and authorities of the Florida state emergency management division are set forth in Chapter 252, Part 1 of the Florida Statutes, entitled the "State Emergency Management Act" (Florida Legislature 1995). The most significant change in Florida emergency management has been the Emergency Management Act, which amended Florida statutes to provide broad powers for the governor to order evacuations and to demand mutual-aid agreements between counties, municipalities, and the state. The current Florida Statutes took effect in 1995 and authorized the governor to promulgate and enforce emergency rules and regulations and to use emergency powers to quell violence (Florida Legislature 1995). The state Division of Emergency Management housed in the Department of Community Affairs, whose secretary reports directly to the governor, provides assistance to the governor in implementing these powers. Former Governor Lawton Chiles set up the Division of Emergency Management under the Department of Community Affairs and appointed a director to lead the emergency program as per FEMA guidelines (Kory 1998).

Each local government must also prepare an emergency operations plan, and the municipalities must align all planning and operations with their respective county agencies. In effect, the Florida Emergency Management Act now empowers counties to approve not only the plans, but also any request for aid by municipalities (Kory 1998). Compliance, cooperation, and coordination are mandated by the state.

According to Kory (1998), despite the new efforts, some counties and many other local governments had not completed an emergency management plan as required by the state, although all counties were issued compliance criteria when the statute took effect in 1995. Counties were to have completed and submitted their emergency plans to the state by the end of September 1996. Furthermore, few municipal and county charters were amended to implement the state procedures. Although the statute does not require municipal governments to amend their charters through passage of an ordinance, this action would clearly delineate the power and authority of a designated official in the event of a disaster and would provide for continuity of government (Kory 1998).

IMPLEMENTING EMERGENCY MANAGEMENT LEGISLATIVE DIRECTIVES

Following the Lewis Commission, the Division of Emergency Management (DEM) has pursued an aggressive program to enhance Florida's ability to effectively respond to major disasters. Part of this program included a revised philosophical approach to disaster events (Koutnik 1999). Rather than tackle each disaster as a separate event, the DEM began using an all-hazards approach emphasizing the common consequences of all disasters, such as displaced populations that need shelter and feeding and damaged infrastructure. In conjunction with consequence management, the DEM organized state agencies into Emergency Support Functions in order to operate from a functional approach as FEMA does.

By 1995, the Florida Department of Community Affairs reported that it had virtually completed the implementation of the Lewis Committee recommendations, aimed to address the preparedness, response, and recovery inadequacies. As mentioned above, the recommendations addressed issues pertaining to deficiencies in communication, planning, coordination, and training. The state also proposed shifting priorities to "focus on mitigation . . . to reduce Florida's vulnerability to loss of life and property"(Florida DCA 1995:3).

With regard to planning, the Division of Emergency Management has developed a Comprehensive Emergency Management Plan that outlines the emergency system used to apply the four phases of emergency management (mitigation, preparedness, response, and recovery). The continued development of an all-hazards planning approach has standardized the functional framework under which strategies and resources are used to minimize the consequences of any event. The Comprehensive Emergency Management Plan unifies the efforts of the state agencies, local governments, and voluntary organizations for a comprehensive approach to maximize the use of all resources within the state (Florida DCA 1999). This plan also provides for an integrated and coordinated local, state, and federal response.

The Florida Division of Emergency Management has incorporated FEMA's concept of the Partnership Performance Agreement at both the state and local level (Koutnik 1995). At the local level, Florida is in a unique position to offer each of its counties base grants from its Emergency Management Preparedness and Assistance Trust Fund. These funds were allocated at one time to counties based on their commitment to develop a five-year strategic plan. Since that time, these plans have become the scope of work for successive years of funding, thus giving each county the ability to tailor its program to meet its needs (Koutnik 1995).

Now each county emergency management agency identifies new issues or areas needing improvements through a programmatic self-assessment. The assessment is a comprehensive list of activities and capabilities that a model emergency management program would possess, and allows the user to determine their capabilities in each functional area (Florida DCA 1999). Places where deficiencies are realized then become focal points of the strategic plan.

The state has done the same. Florida's five-year strategic plan is based on a self-assessment of capabilities, initially completed after Hurricane Andrew ravaged the southern part of the state (Koutnik 1995). Based on that assessment, the state developed a strategic plan that focussed on correcting identified deficiencies. Each year the plan is updated, based on new trends or federal initiatives. The unique aspect of Florida's plan is that it has become the Comprehensive Agreement for federal funding (Koutnik 1995).

In order to provide the same type of leadership to Florida counties that FEMA provided to states through the Performance Partnership Agreement, a group of several small, medium, and large county emergency management representatives have been placed on a task force to assist DEM in developing a State/County Agreement, similar in function to that of the current Performance Partnership Agreement (Florida DCA 1999). This will provide statewide programmatic consistency and will eventually lead to a standardization of emergency management practices in Florida, heading toward a process of accrediting county programs (Florida DCA 1999).

In the area of communications and warning, in 1998 Florida was the first state to receive a major mitigation grant to develop a comprehensive, multi-faceted, warning program, the Florida Warning and Information Network (FWIN) (Florida DCA 1999). This network enhances the communication linkages between each county warning point and the state and increases the National Weather Service warning coverage to 97 percent of the state, one of the highest percentages in the nation (Florida DCA 1999). The Division was able to purchase, through the Florida Warning and Information Network, 10,000 NOAA Weather Radios for distribution to at-risk populations in schools, mobile home parks, day care centers, and adult living centers.

In order to enhance coordination, the state has developed and distributed the Statewide Mutual-Aid Agreement to municipalities and counties to augment resources in disasters that impact the state. After execution, participating counties and municipalities "can use it to request resources, be reimbursed for resources requested of them, track their use, etc" (Florida DCA 1995:29). As of 1999, 67 counties and 426 municipal agreements out of a possible 433 have been approved (Florida DCA 1999).

The Division continues to develop a statewide, coordinated strategy for multi-regional evacuations during severe tropical weather and other hazards. The state has initiated a program that focuses on evacuation and sheltering in Florida as a statewide process. The regional evacuation concept will integrate the operations of local emergency management, law enforcement, sheltering organizations, public information offices, other state agencies, and adjacent states into one plan that will manage the decision making, implementation, and conduct of evacuations for entire regions (Florida DCA 1999). Seven evacuation regions will plan for, coordinate, and execute regional evacuation response.

Florida's continued growth has left the state with a deficit of safe hurricane shelter space (Florida DCA 1999). The Division of Emergency Management has undertaken a multi-faceted program to survey the existing shelter inventory facilities and identify additional capacity, to perform retrofit or other measures on existing buildings to provide additional shelter capacity, and to incorporate a public shelter design criteria into new public building construction projects (Florida DCA 1999).

The coordination of state and local efforts has been enhanced by the state Division of Emergency Management, which provides an extensive training program in each county at central emergency operations centers (Kory 1998). These three and four-day seminars are attended by fire, police, public works, and transportation officials as well as by representatives of volunteer organizations. The majority of the courses have been developed by FEMA and address all hazards and all phases of emergency management. The seminars offer simulations so that teams can learn to solve problems together to prepare for and respond to emergencies and to assess and assist in recovery operations. With the inclusion of Miami as a site for a portion of the soccer playoffs for the 1996 Summer Olympics, a special course in terrorism was added (Florida DCA 1999). There have also been field exercises dealing with nuclear radiation leaks and hazardous materials spills. From 1997 to 1999 the Training and Exercise Section trained over 4100 individuals in more that 90 courses (Florida DCA 1999). The state predicts that its training initiatives will "result in a trained cadre of professionals at all levels of government, as well as volunteer organizations" (Florida DCA 1995:39).

In line with the state's focus on mitigation, in 1998 Florida was named a Pilot Management State by FEMA as a means of expediting the Hazard Mitigation Grant Program (Florida DCA 1999). Under this designation, Florida is allowed to manage major portions of the Hazard Mitigation Grant Program usually handled by FEMA, theoretically eliminating bureaucratic red tape. This new streamlined approach to project management has created an expedited review process that allows funding obligations to be completed within 24 months of a declared disaster date (Florida DCA 1999). Responsibility for eligibility review is delegated to Florida, along with cost effectiveness, environmental compliance, and grants management procedures.

The state has contracted with every county in Florida to develop a Local Mitigation Strategy. In these contracts, county representatives are required to solicit cooperation and develop agreements with municipalities located within their geographic area. The essence of the Local Mitigation Strategy is broad-based, pre-disaster planning, providing a highly effective and analytical method of integrating hazard mitigation into routine policy decision-making as well as the capital improvement programs of local governing bodies (Florida DCA 1999). Each county conducts a hazard identification and vulnerability assessment and then identifies a prioritized list of hazard mitigation initiatives with an accompanying action plan for their implementation. In addition, the state is marketing the concept of mitigation and its comprehensive mitigation program to communities, decision makers, the development community, and to the public (Florida DCA 1999).

CONCLUSION

This chapter briefly describes the development of the Florida Division of Emergency Management and the statewide emergency management organization. The evolution is based upon addressing Florida's special vulnerabilities to many different types of natural and technological hazards given the state's geographical position and demographic composition. During the last decade or so, a variety of studies discussed the limitations of Florida's emergency management system in relation to its vulnerabilities, but no major action was taken to improve the structural readiness and human capital of emergency management in the state. By 1990 it became evident that an overhaul of the emergency management system was needed, but this was not accomplished until two significant disasters took place: Hurricane Andrew in 1992 and the winter storm of 1993. Since then, a new approach to emergency management has developed through legislation and organization that addresses the five critical areas of communication, planning, coordination, mitigation, and training. A more sophisticated system of emergency management has evolved progressing from a simple linear structure to a complex web of interlocking coordination and decision-making processes. As a result, the state of Florida is better prepared to meet the challenge of its particular natural and technological hazards with one of the foremost emergency management programs in the nation.

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