Incident Command System as a Response Model Within Emergency Operation Centers during Hurricane Rita

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This study examines the degree to which the use of the Incident Command System (ICS) influenced the performance of Texas emergency operations centers (EOCs) during Hurricane Rita. Staff in evacuation, transition, and host county EOCs completed a questionnaire that assessed demographic variables, EOC physical environment, ICS experience, ICS implementation, and team climate. The results indicated that the duties each ICS section performed varied substantially from one EOC to another. Moreover, ICS experience and ICS implementation lacked statistically significant correlations with team climate, even though EOCs' physical environments did. Finally, staff from *emergency relevant* agencies (e.g., public works and social services) seemed to have more problems with ICS than did staff from *emergency mission* agencies (e.g., fire and police departments). Thus, there needs to be further study of ICS application in emergencies other than structural and wildland fires, as well as the development of new ICS training materials for emergency relevant agencies to supplement the current ICS training materials for emergency mission agencies.

1. Introduction

Major environmental emergencies are typically characterized by 'uncertainties, multiplicity of actors, masses of information, major surprises, cross-over events, and abrupt changes' (Lagadec, 2002, p. 159). Uncertainty about the current situation and its prognosis, conflicts over who has the authority and resources to respond, and the need to work effectively with unfamiliar individuals and organizations has led to the development of standardized incident management systems (IMSs) for emergency response. Some of these IMSs have been designed to be consistent with general principles of organizational management and appear to perform well when used by highly trained response personnel in routine emergencies (Bigley & Roberts, 2001). However, these IMSs have been subjected to surprisingly few empirical tests of their effectiveness in other contexts (Crichton, Lauche, & Flin, 2005; McLennan, Holgate, Omidei, & Wearing, 2006). Thus, research is needed to determine if there are situations in which these IMSs reveal significant limitations and, consequently, need further refinement.

1.1. The incident command system (ICS)

One of the most prominent IMSs is the ICS, which was developed in the aftermath of the September 1970 Southern California wildfires that burned over 600,000 acres (250,000 ha) and destroyed 772 structures in 13 days. These fires spanned federal, county, and city boundaries, requiring response by over 100 different agencies (Irwin, 1989). Sometimes, fire units from different jurisdictions passed each other without communicating – even though one was heading to put out a fire in the sector the unit they passed had just come from. Some sectors were overlooked because everyone thought others were taking care of those sectors. On the whole, no fire department knew what the others had done, were doing, or planned to do.

To improve coordination during subsequent disasters, the United States Forest Service led a task force (FIRESCOPE) that was supported by state, county, and city agencies (Irwin, 1989). This task force identified numerous problems associated with the response: overloaded spans of control, variations in emergency response organizational structures, lack of reliable information, inadequate and incompatible communications, lack of interagency coordination, unclear lines of authority, lack of common terminology among responding agencies, and unclear or unspecified incident objectives.

Over the next 30 years, the ICS was developed and revised to resolve these problems. Although different versions of ICS have been proposed, the variations among them are relatively small. More recently, flaws in the response to the World Trade Center terrorist attacks led to the development of the National Incident Management System ICS (NIMS ICS), which must be adopted by any state or local jurisdiction receiving financial support from the federal government. According to the ICS-300 training manual, ICS increases organizational effectiveness through 14 features: (1) common terminology, (2) modular organization, (3) management by objectives, (4) reliance on an Incident Action Plan, (5) chain of command and unity of command, (6) unified command, (7) manageable span of control, (8) pre-designated incident locations and facilities, (9) resource management, (10) information and intelligence management, (11) integrated communications, (12) transfer of command, (13) accountability, and (14) deployment (FEMA, 2005).

1.2. Assessments of ICS effectiveness

ICS has been scrutinized by social scientists studying disaster response (Drabek, 1985; Drabek, 2005; Neal & Phillips, 1995; Schneider, 1992; Trainor, 2004; Wenger, Quarantelli, & Dynes, 1990). Because ICS is based on a command and control concept, Wenger et al. (1990) suggest that only quasi-military organizations such as law enforcement and fire service can successfully implement such a response structure. Tight discipline is already established in these organizations and is used on a regular basis. These researchers contended that organizations with normal civilian structures, such as public works and social services, cannot operate as effectively under such a structure.

Another criticism has been ICS's neglect of volunteers and emergent organizations (Drabek, 1985; Drabek, 2005; Neal & Phillips, 1995; Schneider, 1992; Trainor, 2004; Wenger et al., 1990). Schneider (1992) contended that emergency response personnel operate under false assumptions of social behavior in times of disasters – thinking of ordinary citizens as impediments rather than possible emergency response resources. Thus, ICS lacked mechanisms for absorbing volunteers, which left gaps in the overall response effort. According to Neal and Phillips (1995), this neglect of volunteers ignores the *Emergent Human Resources Model*, which advocates the incorporation of emergent volunteers into an organized emergency response.

At the time of these critiques by disaster researchers, ICS was a relatively new concept that had no standardized implementation. Wenger et al. (1990) argued that this is an inherent problem within the ICS response model. 'The concept of the ICS has become a "buzzword" in emergency planning and fire agencies; that buzzword bears little relationship to any actual detailed management model' (p. 8). At the time of their analysis, this criticism was unquestionably accurate. However, others argued that this is not an inherent deficiency of ICS itself, but rather due to ineffective implementation (Hansen, 2007). More recently, the Department of Homeland Security (2004) expanded upon the original FIRESCOPE version of ICS, going so far as to include volunteer agencies and other governmental entities outside of law enforcement and fire service. In doing so, ICS has addressed the criticisms of Wenger and his colleagues, although it is not clear to what extent these reforms are being implemented in actual emergency responses.

Despite the use of ICS for 30 years, there have been very few empirical studies of its effectiveness. Bigley and Roberts (2001) used document reviews, observations, and interviews, to examine ICS use within the fire department of a major metropolitan area. They contended that ICS provided mechanisms for rapidly modifying formal organizational structures, constraining improvization, and managing emergency responders' cognitions. They also concluded that these mechanisms led to organizational reliability in an emergency response. Specifically, they noted that 'to the extent an organization has the capacity to implement preplanned organizational solutions rapidly enough to meet the more predictable aspects of an evolving incident, potential reaction speed is increased, depletion of cognitive and other resources is reduced, and the probability or organizational dysfunction is diminished' (Bigley & Roberts, 2001, p. 1297).

More recently, Buck, Trainor, and Aguirre (2006) conducted a systematic qualitative assessment of ICS effectiveness in nine incidents ranging from the Northridge earthquake to the 9/11 terrorist attacks on the

World Trade Center and Pentagon. They acknowledged the many ways in which ICS promoted effective emergency response but qualified their endorsement by noting 'For ICS to be effective as a tool to coordinate the response, it must be used by a community of *official* responders who through *training and shared experiences*, over years of public service develop *technical confidence and interpersonal trust* in each other' (p. 14, emphasis in the original).

1.3. Potential contextual variations in ICS effectiveness

The conflicting conclusions generated by different studies can at least partially be resolved by considering the ways in which ICS affects the functioning of multi-organizational networks and individual emergency response organizations. Specifically, Bigley and Roberts' (2001) positive assessment of ICS did not contradict – or, for that matter, even address – disaster researchers' concerns about ICS's limitations. Specifically, Bigley and Roberts (2001) only addressed the effectiveness of ICS for managing the response of a single agency (e.g., a fire department) to a routine emergency, not the response of a multiorganizational network that involves many government agencies, private sector organizations, emergency organizations, and unorganized volunteers in a community-wide disaster or regional catastrophe. ICS would be expected to vary in its effects on organizations depending on the nature of those organizations. Dynes's (1970) typology suggests ICS's positive effects would be the greatest on *existing* emergency response organizations performing their normal tasks with normal staff (especially *emergency mission organizations* such as police, fire, and EMS). ICS would have somewhat less impact on *expanding* emergency response organizations that perform their normal tasks with additional staff and still less impact on *extending* emergency response organizations performing novel tasks with their normal staff (i.e., *emergency relevant organizations* such as public works and social services). Finally, ICS would have the least impact on *emergent* emergency response organizations that perform novel tasks with new staff.

As indicated in Table 1, variations in ICS effectiveness across these different types of organizations would be attributable to their relative amount of ICS training as well as their relative frequency of drills, exercises, and incidents in which these organizations implement ICS. Moreover, one would expect that effectiveness would decline as the scope of the incident increased from a local emergency to a community-wide disaster, and then to a regional catastrophe. This second proposition follows logically from the fact that even emergency mission organizations have little training and experience with the demands of community-wide disasters and regional catastrophes.

In addition to having positive effects on individual organizations, ICS would be expected to have positive effects on multi-organizational networks. Drabek, Tamminga, Kilijanek, and Adams (1981) called attention to emergent multi-organizational networks (EMONs) that are sometimes improvised by organizations converging on the scene of an incident. However, there are also planned multi-organizational networks (PMONs) that are structured before an incident occurs and mixed multi-organizational networks (MMONs) comprising some organizations that are expected to participate in an emergency response and others whose participation has not been anticipated. As is the case with individual organizations, variations in multiorganizational network effectiveness would be attributable to their component organizations' amount of ICS training as well as their relative frequency of practice with ICS implementation. These challenges are likely to be particularly acute in emergency operations centers (EOCs) that must coordinate the activities of multiorganizational networks.

1.4. Potential ICS limitations in non-fire emergencies

Although ICS's Command, Planning, Logistics, and Finance/Administration sections have unambiguous functions that seem to be applicable in response to all

Table 1. Expected Effectiveness of ICS

Type of network/organization	Scale of event		
	Routine emergency	Disaster	Catastrophe
Emergent multiorganizational network	N/A	0	0
Mixed multiorganizational network	+ + + +	+ + +	+ +
Planned multiorganizational network	+ + + + +	+ + + +	+ + +
Emergent	N/A	0	0
Extending	+ + +	+ +	+
Expanding	+ + + +	+ + +	+ +
Existing	+ + + + +	+ + + +	+ + +

disaster agents, the function of an Operations section is potentially confusing in non-fire emergencies. This is because an Operations section normally focuses on *hazard source control* activities such as fire suppression and, possibly, hazardous materials containment. However, in other types of incidents, the Operations section must take responsibility for *population protection* activities such as warning, evacuation, and congregate care. Indeed, hurricanes – unlike structural or wildland fires – require *only* population protection activities because there are *no* hazard source control activities to be performed (unless the hurricane causes secondary hazards such as fires or hazardous materials releases). Moreover, the scale of operations in a major hurricane is such that one set of population protection activities – warning and evacuation – will be implemented only in coastal counties and a different set of population protection activities – mass care/shelter – is likely to be implemented only in inland counties. Although the 14 basic features of ICS – common terminology, modular organization, and so forth – are likely to be applicable in such events, it remains to be determined if the specific organizational structure designated in current ICS implementations – especially the Operations section – is effectively implemented during non-fire emergency response.

1.5. Training and experience

Some ICS supporters have responded to criticisms of ICS implementation by attributing poor performance to inadequate training in ICS principles and procedures (Hansen, 2007). Indeed, effective training is an essential element of organizational performance, especially when the situations to which personnel must respond involve tasks that are critical (involve life and death consequences), difficult to learn and perform, and implemented infrequently (Ford & Schmidt, 2000). Effective organizational performance is particularly challenging when members must closely coordinate their action – that is, there is a need for *teamwork* as well as *taskwork* (Salas, Dickinson, Converse, & Tannenbaum, 1992). Indeed, ICS is a standardized organizational structure for emergency response organizations and networks that is specifically designed to promote effective teamwork. In particular, ICS training documents (e.g., FEMA, 2005) focus exclusively on interaction between and within teams and limit their discussion of taskwork to *what* teams (especially ICS Sections) do rather than *how* they do it.

Some of the basic findings of training research are that effective training must address job demands, provide instruction that is based on scientifically valid principles of learning, and be consistent with trainees' readiness and motivation to learn. In addition, transfer of training to the job must be based on an effectively designed program of practice – that is, drills and exercises – if there are not frequent opportunities for task performance (Ford & Schmidt, 2000; Goldstein & Ford, 2002). Drills, exercises, and incidents allow personnel to develop skill in performing their emergency response duties in a timely and effective manner. Experience in emergency response taskwork and teamwork is most likely to be found in emergency mission agencies such as police, fire, and emergency management. It is less likely to be found in emergency relevant agencies such as social services, public works/engineering, agriculture, hospitals/emergency medical services, Chief Administrative Officer's staff, and state/local elected officials.

1.6. Team climate

The 14 features of ICS (i.e., common terminology, modular organization, etc.) are quite similar to variables associated with the descriptive meaning of work environment perceptions as described by James and James (1989). These include '. . . span of control, centralization of decision making, functional specialization, physical space characteristics . . . formal communication networks, and formal rules, regulations, and reward structures' (p. 739). Thus, ICS, as taught in the ICS-300 course (FEMA, 2005), can be expected to affect some important components of *team climate*. Climate is a construct used to conceptualize 'group members' shared experiences and how these experiences influence individuals' perceptions, their behavior, and the success of the group' (Lindell & Brandt, 2000, p. 331). Role stress (role conflict, ambiguity, and overload) has been shown to negatively affect individual and organizational performance by overwhelming group members with conflicting objectives, unclear methods of performance, and excessive workloads, respectively. (Ellis, Bell, Ployhart, Hollenbeck, & Ilgen, 2005; Lindell & Whitney, 1995; Maslach, Schaufeli, & Leiter, 2001; Rizzo, House, & Lirtzman, 1970; Smith & Brannick, 1990; Smith, Tisak, & Schmieder, 1993). Other climate characteristics (team coordination, team cohesion, team task orientation, and team pride) have also been shown to influence individual and organizational effectiveness (Gully, Devine, & Whitney, 1995; Hollenbeck, Ilgen, LePine, Colquitt, & Hedlund, 1998; Lindell, Whitney, Futch, & Clause, 1996; Lindell, Clause, Brandt, & Landis, 1998; Lindell & Brandt, 2000; Stewart, Fulmer, & Barrick, 2005; Whitney & Lindell, 2000). In summary, the 14 features of ICS (e.g., common terminology, modular organization, management by objectives) would be expected to improve individual and organizational effectiveness by improving the team climate within the emergency response organizations.

1.7. EOC characteristics

ICS implementation is not the only variable that can be expected to affect team climate and job satisfaction during EOC activation. EOCs need adequate staffing and organization, as well as suitable information displays and communications media (Lindell & Perry, 2007; Militello, Patterson, Bowman, & Wears, 2007; Perry, 1991, 1995, 2003). Moreover, EOCs are prone to problems such as an inequitable distribution of workload and an inadequate distribution of information, as well as insufficient size and poor layout – both of which lead to noise and congestion (Lindell, 1983, 1985; Lindell, Wise, Desrosiers, Griffin, & Meitzler, 1982; Militello et al., 2007). In turn, these conditions can be expected to adversely affect team climate and individual and organizational performance.

1.8. Demographic characteristics of EOC staff

Recent years have seen an increase in the number of women working in emergency management (Wilson, 1999). However, this does not necessarily mean that women have the same work experiences as men (Phillips, 1990). Accordingly, it is quite possible that women will differ from men in experience and knowledge of ICS, the tasks they perform within the EOC and, the ICS sections to which they are assigned. Although it is possible that older and younger respondents will also display differences on these variables, there is no specific theoretical justification for hypothesizing that such differences will be found.

1.9. Study objectives

The research described in the previous sections leads to five study objectives. The first objective is to assess the level of previous experience among those staffing EOCs during Hurricane Rita. The second objective is to determine if there are systematic differences among a variety of counties in the tasks they perform. The third objective is to examine the degree to which the respondents in different ICS sections (Operations, Planning, Logistics, Finance/Administration) report performing different tasks during the emergency response. The fourth objective is to determine if EOC staff members from emergency mission organizations (i.e., those that respond to routine emergencies) and emergency relevant organizations (i.e., those that have the resources relevant to major incidents) differ in their prior experience and, thus, their responses during Hurricane Rita. Finally, the fifth objective is to determine if variables such as respondents' demographic characteristics, respondents' ICS experience, the EOC's physical characteristics, and the organization's implementation of ICS have an impact on team climate within these EOCs.

2. Method

Ultimately, a comprehensive evaluation of ICS will require multi-method assessments of emergency response a wide range of jurisdictions to a broad range of hazards. However, as an exploratory study, this research examines only the responses of Texas EOCs to a single hurricane. Selection of a the response of a single state to a single incident raises some concerns about generalizability, but does increase internal validity by ensuring comparability across EOCs with respect to the emergency response demands and the political context (Shadish, Cook, & Campbell, 2002).

2.1. Type of incident

Hurricane emergency response provides reasonable conditions for assessing ICS because it requires a variety of organizations to perform a wide range of tasks under conditions of high stress. In particular, hurricane response involves tasks from three generic emergency response functions – emergency assessment, population protection, and incident management (Lindell, Prater, & Perry, 2006). Moreover, a major hurricane requires the utilization of a wide of array of emergency responders from existing, expanding, extending, and emergent organizations. By contrast, containing a wildfire (the type of emergency for which ICS was designed) may only employ a fraction of these response activities. Therefore, a hurricane response encompasses more responders and imposes many more strains than the wildfires that were considered during the original development of ICS.

The specific event addressed in this study, Hurricane Rita, first originated off the west coast of Africa on September 7, 2005, as a tropical wave (Knabb, Brown, & Rhome, 2006). Over the next few weeks, it gained strength and eventually was classified as a hurricane on September 20, 2005, when it was east-southeast of Key West, FL. On September 21, 2005, Rita entered the Gulf of Mexico as a Category 3 hurricane with a track toward Corpus Christi, TX. Over the next 24 hours, its projected path shifted eastward along the Texas coast, increasing to a Category 5 hurricane with 155-knot (290 km/hour) winds. On the morning of September 24, 2005, Hurricane Rita made landfall between Sabine Pass, TX, and Johnson's Bayou, LA, as a Category 3 hurricane.

To fully capture the activities required by the response to Hurricane Rita, jurisdictions were identified as evacuating jurisdictions, host (or sheltering) jurisdictions, and transitional jurisdictions. Transitional jurisdictions are those that were originally hosts but, because of Hurricane Rita's changing path, became evacuation jurisdictions. Jurisdictions in this category could experience additional strains because they had to alter their response activities.

2.2. Measures

Respondents were asked to rate the extent (1 = *Not at all* to 5 = *Very great extent*) of their involvement in 14 tasks: sheltering, evacuation, communications, food distribution, donation collection, volunteer coordination, security, traffic management, press releases, fire inspections, resource management, search and rescue, debris removal, and social services. In addition, they were asked to report the ICS section (Planning, Operations, Logistics, Finance & Administration, Other) to which they were assigned, how well they understood ICS principles (1 = *No knowledge* to 5 = *Expert*), if their EOC used ICS during the hurricane (0 = *No*, 1 = *Yes*), and if their EOC had an Incident Commander (0 = *No*, 1 = *Yes*). Respondents also were asked how frequently they had used ICS (1 = *Never*, 2 = *Yearly*, 3 = *Monthly*, 4 = *Weekly*, 5 = *Daily*). These responses were converted to the corresponding number of days per year – 0, 1, 12, 52, and 365, respectively) (Table 2).

In addition, respondents were asked to describe the EOC's physical environment in terms of the degree to which their performance was negatively affected by four separate factors – size, layout, congestion, and noise (1 = *Not at all* to 5 = *Very great extent*). In addition, they were asked to report the number of EOC activations in which they had participated.

To assess organizational climate, respondents were asked a series of questions pertaining to role stress and team task orientation that Lindell et al. (1996) and Lindell and Brandt (2000) adapted from an instrument developed by James and his colleagues (James & James, 1989; James & Sells, 1981). Those items addressing role stress included scales measuring role ambiguity (six items, 1 = *Strongly disagree* to 5 = *Strongly agree*), role conflict (five items, 1 = *Strongly disagree* to 5 = *Strongly agree*), and role overload (four items, 1 = *Not at all* to 5 = *Very great extent*). In addition, other climate scales measured team coordination (eight items, 1 = *Not at all* to 5 = *Very great extent*), team task orientation (eight items, 1 = *Strongly disagree* to 5 = *Strongly agree*), team cohesion (seven items, 1 = *Strongly disagree* to 5 = *Strongly agree*), team pride (three items, 1 = *Not at all* to 5 = *Very great extent*), and job satisfaction (three items, 1 = *Strongly disagree* to 5 = *Strongly agree*). Finally, respondents were asked to provide information on two demographic variables – age and gender (0 = *Male*, 1 = *Female*).

Although the team climate measures are only relevant to one of the study objectives, they comprise the majority of the items in the questionnaire. This is because the number of items in the climate scales is determined by the need to produce reliable estimates of the constructs being measured. Unlike the respondent's sex or age, which can each be reliably measured with a single item, team climate is a much more elusive construct so the questionnaire used the number of items that previous research indicated would be necessary.

2.3. Data collection

It is desirable to collect data using multiple measures but there were no readily available alternatives to questionnaires for measuring the variables relevant to the study's objectives – individuals' previous experience with ICS, the tasks they performed during EOC

Table 2. Number of Respondents in each ICS Section

	ICS section						
Agency	Operations	Logistics	Planning	Finance/ administration	Other	Don't know	Total
Homeland security/emergency management	3	1	0	0	5	1	10
Chief administrative officer's staff	0	0	0	0	1	0	1
State/local elected official	4	0	0	0	1	0	5
Emergency medical/hospital	1	0	0	1	0	0	2
Public works/engineering	1	0	0	0	0	0	1
Firefighting	3	0	0	0	2	0	5
Law enforcement	4	2	0	0	0	0	6
Agriculture	1	0	0	0	0	0	1
Other	3	0	1	0	2	0	6
Total	20	3	1	1	11	1	

Note: Some respondents represented multiple agencies and were in multiple sections. For instance, all respondents represented two or more agencies, mainly FD and EM or LE and EM and one respondent was assigned to four sections.

activation, their demographic characteristics, the EOC physical environment, and the EOC team climate. Specifically, observations were not feasible because the two investigators could not be present in all 22 EOCs simultaneously (although the first author was present in one of them). Archival records were not feasible because many of the variables involve personal interpretations. Consequently, a point of contact was identified for each jurisdiction that was asked to deliver copies of the questionnaire to representatives from each organizations participating in the EOC activation. A total of 150 questionnaires were sent to 22 jurisdictions, with each jurisdiction receiving 2–10 questionnaires, and 38 were returned for a response rate of 26%.

2.4. Analyses

The level of inter-rater agreement within each ICS section on task performance was calculated by using an index proposed by James, Demaree, and Wolfe (1984):

$$r_{wg} = 1 - (s_x^2/s_{EU}^2),$$

where s_x^2 is the variance of the respondents' ratings and s_{EU}^2 is the variance of the uniform distribution. This index ranges in the interval $-1 \leq r_{wg} \leq +1$ where large positive values indicate strong agreement, zero values indicate disagreement, and large negative values indicate polarization into two opposing groups (Lindell, Brandt, & Whitney, 1999).

3. Results

As Table 3 indicates, 28 respondents were male and 10 were female; their average age was 46.8, with the youngest being 27 and the oldest being 59. Most of the respondents were between the ages of 40–49 (13 respondents) and ages 50–59 (16 respondents). Moreover, there were 29 respondents reporting the use of ICS within their EOC, of which 26 reported having an incident commander (IC). Remarkably, the three respondents that reported using ICS and not having an IC did not report using Unified Command – which is what ICS doctrine requires if there is no single IC. There was one respondent who reported not using ICS; however, this was contradicted by other members of the same EOC who did report using ICS. In addition, there were seven respondents who reported not using ICS within their EOC but, of these, one respondent reported having an IC. Moreover, of the seven respondents who reported not using ICS, five did report being a part of an ICS section.

Of the respondents who reported being a part of an ICS section, the majority were in Operations (20).

Table 3. Descriptive Statistics for Questionnaire Variables

Variable	Range	Overall mean	Emergency mission[a]	Emergency relevant[b]
Age	27–59	46.8	48.0	44.7
Gender (male)	0–1	.74	.92	.43
EOC environment	1.0–5.0	3.3	3.3	3.2
Number of EOC activations	1–59	11.1	13.8	6.5
ICS use frequency	0–365	44.6	64.6	2.8
ICS understanding	1–5	3.4	3.7	2.8
Rita: EOC used ICS	0–1	.8	.8	.9
Rita: EOC had IC	0–1	.8	.7	.8
Role clarity	2.2–5.0	4.0	3.8	4.3
Role conflict	1.7–5.0	3.6	3.4	4.0
Role overload	1.0–4.3	2.4	2.7	2.1
Team cohesion	1.8–5.0	4.0	4.1	3.8
Team coordination	2.9–5.0	4.2	4.2	4.2
Team task orientation	2.6–5.0	4.1	4.1	4.1
Team pride	2.3–5.0	4.3	4.4	4.2
Job satisfaction	2.0–5.0	4.4	4.4	4.4

Notes: [a]Police, Fire, Emergency Management.
[b]Chief Administrative Officer staff, State/local elected official, Emergency medical/Hospital, Public works/Engineering, Agriculture, Other.

As one would expect, the majority of fire and police personnel were in the Operations section. Interestingly, however, four of the five elected officials also reported being in the Operations section. Those reporting 'Other' were in the second largest group at 11 respondents, many of whom (5) were acting as IC or as part of Unified Command. Moreover, as one might expect, most emergency management and chief administrative officer's staff also reported 'Other.' This result suggests that 'Other' was, effectively, 'Command.' There were only three respondents in Logistics, and one apiece in Planning and Finance/Administration.

There was a significant range in the number of previous EOC activations in which the respondents had participated (1–59) and the frequency of ICS use (from *never* = 0 to *daily* = 365). These distributions were highly skewed, with many more cases at the low end of the range than at the upper end of the range. There was also a significant range in the level of ICS understanding (1–5), the quality of the EOC physical environment (1.0–5.0), and the level of role conflict (1.7–5.0) and role overload (1.0–4.3). However, there were much smaller differences in the level of team coordination (2.9–5.0) and team task orientation (2.6–5.0).

3.1. Differences in EOC tasks performed by county type

Figure 1 shows task performance ratings for the evacuation, transition, and host counties. The task profile for the transition counties shows substantial

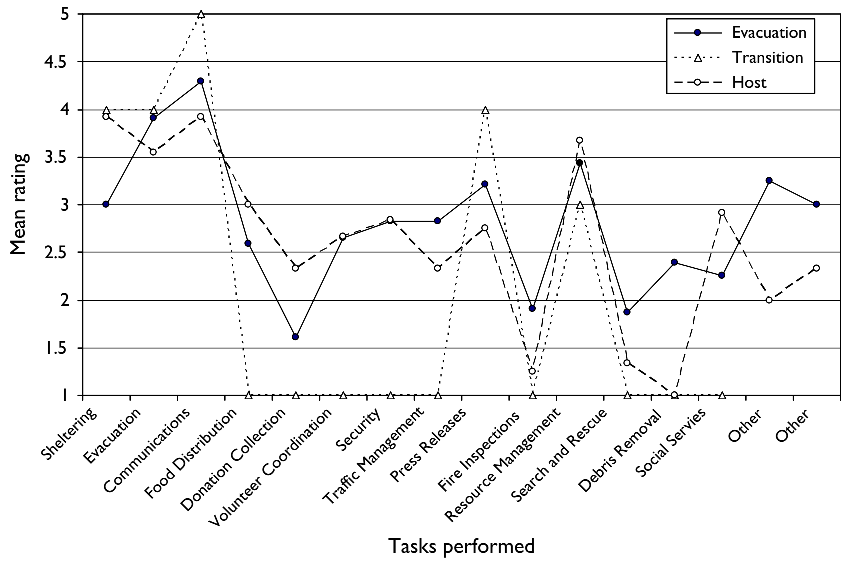

Figure 1. Task Profile by Type of Emergency Response (Evacuation and Host).
Note: There was only one respondent from a Transition county.

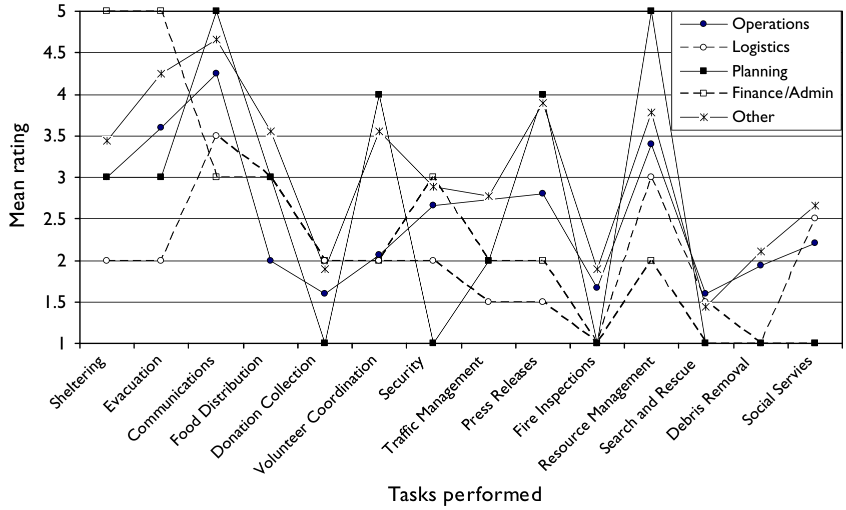

Figure 2. Task Profiles for each ICS Section.

variation in the tasks performed. However, there was only one respondent from a transition county, so statistical analyses were conducted only on evacuation and host counties. Surprisingly, the only task for which there were statistically significant differences between evacuation counties ($M = 2.39$) and host counties ($M = 1.0$) was debris removal ($t_{33} = 46.7$, $p < .01$).

3.2. Differences in EOC tasks performed by ICS section

Figure 2 indicates substantial variation in the degree to which each ICS section was involved in each of the tasks. However, the Planning and Finance/Administration sections had only one respondent apiece, so they were deleted from the statistical analyses. Analyses of Variance over the remaining three groups (Operations, Logistics, and Other/Command) indicated statistically significant differences only in the levels of volunteer coordination ($F_{2,23} = 4.6$, $p = .02$) and food distribution ($F_{2,23} = 3.4$, $p = .05$).

It is somewhat surprising that there were any statistically significant differences because Table 4 shows the levels of interrater agreement were quite low for volunteer coordination ($r_{wg} = .32$ for Operations and .24 for Other/Command) and were even worse for food distribution ($r_{wg} = .00$ for Operations and $-.26$ for Other/Command). Indeed, the only tasks for which there were reasonably high levels of interrater agreement were communications ($r_{wg} = .57$ for Operations and .75 for Other/Command) and search and rescue ($r_{wg} = .61$ for Other/Command).

Table 4. Interrater Agreement on Tasks within Operations and Other Sections

Tasks	Operations ($n = 20$)	Other ($n = 11$)
Sheltering	−.50	−.14
Evacuation	−.20	−.11
Communications	.57	.75
Food distribution	.00	−.26
Donation collection	.30	.19
Volunteer coordination	.32	.24
Security	−.19	−.18
Traffic management	−.32	−.60
Press releases	−.23	−.43
Fire inspections	.17	.07
Resource management	.30	.28
Search and rescue	.30	.61
Debris removal	−.18	−.43
Social services	−.09	−.38

3.3. Differences among emergency mission and emergency relevant agencies

Table 3 also shows that respondents from emergency mission agencies reported a significantly greater percentage of males (92%) than did the emergency relevant organizations (43%), a difference that was statistically significant ($\chi^2 = 10.9$, $p \leq .001$). Moreover, emergency mission agencies reported a significantly greater degree of ICS understanding than did respondents from emergency relevant agencies. However, there were no significant differences between the two types of respondents with respect to the number of EOC activations, ICS use frequency, EOC environment, reported use of ICS during Hurricane Rita activation, team climate, or job satisfaction.

3.4. Correlations of demographic, EOC, ICS and team climate variables

Bivariate correlation analyses (Table 5) reveal the two demographic variables had only one significant correlation (of 28 possible) with other variables. This is slightly less than the number that would be expected by chance (1/28 = 3.4%), which suggests this correlation has no practical significance. EOC physical environment had no significant correlations with ICS experience or ICS implementation, but had seven (of eight) significant correlations with team climate. By contrast, the number of EOC activations had one significant correlation with understanding of ICS principles but no significant correlations with other aspects of ICS experience, ICS implementation, or team climate. The ICS experience variables had two significant correlations out of 20 with ICS implementation and team climate (10% of the correlations were statistically significant), and ICS implementation variables had no significant correlations with team climate. Finally, consistent with previous research, almost all of the intercorrelations among the team climate variables were statistically significant.

4. Discussion

Regarding the first objective (assessing the level of previous experience among those staffing EOCs during Hurricane Rita), the data indicate substantial variation among the respondents in their EOC activation experience and ICS use frequency. Moreover, there were significant differences between emergency mission and emergency relevant agencies in their EOC activation experience and ICS use frequency. Given the

Table 5. Intercorrelations among Demographic, EOC, ICS, and Team Climate Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	1.0														
2. Gender	−.26	1.0													
3. Number of EOC activations	.07	−.32	1.0												
4. EOC environment	−.18	−.25	.09	1.0											
5. Understand ICS principles	−.06	−.48^{b}	.48^{b}	.28	1.0										
6. ICS use frequency	−.11	−.50^{b}	.39^{a}	.73^{b}	.72^{b}	1.0									
7. EOC use of ICS in Rita	−.18	.09	.04	−.05	.15	.17	1.0								
8. EOC IC in Rita	−.02	.03	−.12	−.26	.11	−.02	.69^{b}	1.0							
9. Role ambiguity	.34	.30	−.13	−.19	−.25	−.16	.19	.23	1.0						
10. Role conflict	−.30	−.13	.10	.07	.36^{a}	.17	−.12	.02	−.71^{b}	1.0					
11. Role overload	−.27	−.17	.04	−.21	.41^{b}	.06	−.13	−.09	−.58^{b}	.65^{b}	1.0				
12. Team cohesion	.01	.06	.12	.05	−.02	.09	−.05	.10	.47^{b}	−.36^{a}	−.49^{b}	1.0			
13. Team coordination	.17	.06	.13	.07	−.07	.06	−.13	−.11	.59^{b}	−.55^{b}	−.36^{a}	.80^{b}	1.0		
14. Team task orientation	.28	.07	.12	.06	−.18	.01	.04	.03	.64^{b}	−.68^{b}	−.39^{a}	.75^{b}	.59^{b}	1.0	
15. Team pride	.05	.04	.23	.13	.07	.17	.02	.13	.44^{b}	−.26	−.56^{b}	.72^{b}	.84^{b}	.65^{b}	1.0
16. Job satisfaction	.10	.18	.18	.13	.08	.24	.08	.12	.72^{b}	−.45^{b}	.68^{b}	.73^{b}	.74^{b}	.69^{b}	−.50^{b}

Note: $^{a}p \leq .05$; $^{b}p \leq .01$.

differences in experience, it is no surprise that there were also significant differences in ICS understanding. What is surprising is that the differences in ICS understanding were relatively small.

Regarding the second objective (determining if there are systematic differences among evacuation, transition, and host counties in the tasks they performed), the data indicate only one significant difference between evacuation and host counties; evacuation counties did more debris removal (although not a lot, but host counties did none). Most of the other differences were relatively small (about .5 unit on a five-point scale) and there were a few strong similarities. These results suggest that task performance in evacuation and host counties is similar enough that they can probably use identical organizational structures for managing hurricane emergency response. That is, in addition to using ICS, they could probably also use identical branch structures within the Operations section.

Regarding the third objective (examining the degree to which the respondents in different ICS sections report performing different tasks during the emergency response), the data indicate only relatively minor differences in the tasks performed by the different ICS sections. Indeed, the most remarkable finding in Figure 2 is the *lack* of specialization of function. Although one would expect that each ICS section would have its own distinctive profile – having very high involvement in some tasks but very low involvement in others – this does not seem to have been the case. Instead, Figure 2 shows that the profiles for Operations, Logistics, and Other/Command (the sections with the largest sample sizes and, thus, the most reliable data) tended to be parallel to each other. Other/Command had the highest involvement in most tasks, followed by Operations, and then Logistics. Moreover, Table 4 indicates that, not only did all the sections tend to be involved in all the tasks, there also tended to be little agreement within each type of section regarding what functions they performed. That is, where one EOC's Operations section might be highly involved in a specific task (e.g., sheltering) another EOC's Operations section might have minimal involvement in that task.

Regarding the fourth objective (determining if EOC staff members from emergency mission organizations and emergency relevant organizations differ in their prior experience and responses during Hurricane Rita), the data indicate that members of emergency mission organizations differ from those of emergency relevant organizations only in their prior experience, not in their responses during Hurricane Rita. As noted earlier, the very large differences in EOC activation experience and ICS use frequency produced surprisingly small difference in ICS understanding and no significant differences in team climate or job satisfaction.

Regarding the fifth objective (determining if respondents' demographic characteristics, respondents' ICS experience, the EOC's physical characteristics, and the organization's implementation of ICS have an impact on team climate), the data indicate no significant correlations of age or gender with team climate variables. However, there was a significant correlation of gender with ICS understanding (with males reporting a greater understanding) and ICS use frequency (with males also reporting a greater frequency of ICS use), as well as between the number of ICS activations and ICS understanding. The statistically significant correlation of ICS use with ICS understanding supports the idea that those who use ICS more often probably do understand it better. The only other significant correlation among background variables was between 'Rita: ICS use in the EOC' and 'Rita: EOC had IC' which, as noted earlier, would be expected to be 1.0 but was not.

It is notable that one respondent stated 'We did not use the ICS in our EOC, but we did at the Sheriff's office to get things done.' This comment supports the contentions of Buck et al. (2006) and others that ICS may be more effective in organizations that normally have a strong command and control form of organization. Another respondent stated, 'Our EOC simply did not have enough staffing. This caused primary workers to be overworked and unable to take rest and sleep breaks.' This is despite the fact that ICS was implemented within this particular EOC. Thus, it may be that staffing levels in some EOCs were too low to provide the human resources that ICS needs to function effectively. However, no data were collected in this study that could test this proposition, so the issue needs further study.

Moreover, the implementation of ICS during Hurricane Rita had no significant correlation with team climate or job satisfaction. That is, there were no significant differences in the effectiveness of the organizational process between EOCs that employed ICS and those that did not. As noted earlier, one would expect the use of ICS to decrease role conflict and work overload, while increasing role clarity, team task orientation, team coordination, team cohesion, team pride, and job satisfaction. However, this is not the case.

Instead, the physical environment in which ICS was employed had a more significant correlation with the organizational process than did ICS implementation itself. That is, the major factor affecting the organizational process was the physical environment in which it occurred. The EOC environment had significant correlations with all role stress and team indicators with the exception of team pride, with the lowest correlation being job satisfaction ($r = .36$) and team coordination ($r = .68$) being the highest. As would be expected, the EOC environment was negatively correlated with role conflict and work overload ($r = -.49$ each). Likewise, EOC environment is positively correlated with the other role stress and team indicators.

5. Conclusions

Practitioners (Hansen, 2007; Irwin, 1989) and researchers (Bigley & Roberts, 2001) have praised ICS for its adoption of general management principles that provide the foundation for high reliability organizations. Thus, it is important to note that this study's results do not contradict the contention that ICS is superior to the wide variety of emergency management structures that it is replacing. However, it is clear that ICS implementation in Texas EOCs during Hurricane Rita left much to be desired. Thus, this case study suggests that ICS, as currently designed and trained, does not generalize well to all types of organizations responding to all types of hazards. In this regard, it is important to recall that ICS was developed to organize multijurisdictional response to wildfires and is usually implemented by fire departments that use it daily.

The finding that ICS has some deficiencies is consistent with previous criticisms (Drabek, 1985; Drabek, 2005; Neal & Phillips, 1995; Schneider, 1992; Trainor, 2004; Wenger et al., 1990), but the present results point to rather different reasons for the problems observed in Hurricane Rita EOCs. Previous studies have criticized ICS's neglect of the contributions that can be made by volunteers and emergent organizations during emergencies but the Hurricane Rita EOC results seem to agree with Hansen (2007) that ICS implementation problems are due to training deficiencies. However, the solution does not seem to be to provide more of the current type of ICS training because the Hurricane Rita data indicate that amount of ICS training was unrelated to EOC performance. Indeed, it is the current training materials that seem to be the problem. As one respondent stated, 'I am not familiar with ICS in a practical sense. I have been involved in training but they are very dry. I would be interested in a mentoring program where individuals not familiar could use the "buddy" system to walk thru a "typical" event with others who have the real life application.' This observation indicates that more attention should be given to developing new forms of ICS training. Current training materials that are designed for emergency mission agencies, which implement ICS daily, should be supplemented with new training materials that are designed for emergency relevant agencies that do not participate in frequent incident responses. Indeed, this conclusion reinforces and extends that of Buck et al. (2006), who reported that effectiveness in nine incidents ranging from the Northridge earthquake to the 9/11 terrorist attacks was greatest when ICS was implemented by official responders (emergency mission agencies) who had years of training and shared experience.

The difference in the training needs for emergency mission and emergency relevant agencies is attributable to the fact that ICS was originally designed to structure onscene operations in structural and wildland fires, not EOC operations in other types of incidents. For example, ICS training materials specifically discuss air operations and other firefighting activities but ignore population protection activities such as evacuation and mass care (FEMA, 2005). More generally, ICS training materials implicitly treat the Operations section as a 'garbage can' to which tasks are assigned if they do not clearly belong in one of the other sections – Command, Planning, Logistics, or Finance/Administration. Lack of guidance about the 'proper' section assignment for many of these tasks might have been the fundamental problem that led to inconsistencies among Texas jurisdictions in the ways they implemented ICS in their EOCs during Hurricane Rita. If this is the case, a consensus body will need to identify the universe of disaster tasks – perhaps by organizing the Target Capabilities List (DHS, 2007) into a smaller number of categories – and make authoritative allocations of tasks to ICS sections. Only after these task assignments have been made can more effective ICS training be developed and delivered for EOCs to use in responding to hurricanes and other hazards.

Moreover, the finding that more frequent ICS use does improve ICS understanding but not EOC utilization of ICS or any aspects of the EOC's team climate indicates that further study is needed to examine how other aspects of ICS training, drills, exercises, and incident response are related to the EOC's team climate and organizational effectiveness. For example, the interval between training and performance might be too long for trainees to retain the information, or the conditions of training and routine emergency operations might be inadequate to facilitate effective transfer of training to meet the demands of a major disaster (see Ford & Schmidt, 2000, or Goldstein & Ford, 2002, for more detailed lists of possible training deficiencies). Moreover, it will be important to avoid any gender biases in training, given the fact that there is a much greater proportion of women within emergency relevant organizations than in emergency mission organizations.

Finally, the Hurricane Rita data call attention to the importance of effective EOC design (Lindell & Perry, 2007; Lindell et al., 1982; Militello et al., 2007; Perry, 1991, 1995, 2003). Indeed, one of the critical needs in EOC design is to identify the positions within the EOC and the workflows from one position to another (Lindell, 1983, 1985; Lindell et al., 1982). Accurate analysis of an EOC's workflow provides the foundation for determining beneficial and incompatible adjacencies.

In turn, this information can guide a design process that will reduce noise and congestion.

These are limitations to this study – in particular, it examined only a single event (Hurricane Rita) in a single state (Texas). Moreover, data were collected only through questionnaires from a limited sample (38 respondents) that severely under-represented some ICS sections (Planning, Logistics, and Finance/Administration). Obviously, more events and more respondents are desirable and should be studied as soon as possible. However, criticizing the sample as unrepresentative would be overly simplistic because the critical issue for any single study is whether there is reason to believe the sample produced misleading conclusions. As noted in Lindell and Perry (2000, see also Lindell, 2008), even a moderate degree of sample unrepresentativeness is unlikely to affect correlation coefficients substantially. Since most of the conclusions were based on the correlations among variables, they are not likely to have been affected. Indeed, rather than claiming universally applicable findings, this study does just the reverse; it has identified limits to the generalizability of ICS as a universal structure for emergency response organizations.

Acknowledgements

This research was made possible through support from the National Science Foundation SES 0527699. The views expressed in this paper are solely those of the authors.

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