© *Academy of Management Journal*
2001, Vol. 44, No. 6, 1281–1299.

THE INCIDENT COMMAND SYSTEM: HIGH-RELIABILITY ORGANIZING FOR COMPLEX AND VOLATILE TASK ENVIRONMENTS

GREGORY A. BIGLEY
University of Washington

KARLENE H. ROBERTS
University of California

The incident command system (ICS) is a particular approach to assembly and control of the highly reliable temporary organizations employed by many public safety professionals to manage diverse resources at emergency scenes. Our inductive study of a fire department's use of the ICS identified three main factors enabling this distinctively bureaucratic system to produce remarkably flexible and reliable organizations for complex, volatile task environments. This research suggests the possibility of new organizational forms able to capitalize on the control and efficiency benefits of bureaucracy while avoiding or overcoming its tendencies toward inertia.

Recent organization science research indicates that an expanding number of organizations are facing increasingly unforgiving social-political-economic contexts (D'Aveni, 1994). Operational failures resulting in inappropriate, incomplete, laggardly, or otherwise mindless organizational responses to unexpected and demanding environmental contingencies (such as major and unforeseen competitive threats, product malfunctions and recalls, supplier collapses, technology breakdowns, and so forth) are ever more likely to be immediately and critically disabling (Hanssen-Bauer & Snow, 1996; Lagadec, 1993; Pearson & Clair, 1998). Consequently, reliability—that is, the capacity to continuously and effectively manage working conditions, even those that fluctuate widely and are extremely hazardous and unpredictable (Weick, Sutcliffe, & Obstfeld, 1999)—is becoming a vital organizational quality or competency.

Traditional bureaucratic (Weber, 1947) or mechanistic systems (Burns & Stalker, 1961) ostensibly become more *un*reliable as situational volatility escalates. In fact, Adler, Goldonftas, and Levine (1999) suggested that one of the most enduring ideas in organization theory is that bureaucracies, which are characterized by structural features such as standardization, specialization, formalization, and hierarchy, enable the steady, efficient functioning organizations require to compete successfully under stable operating conditions, but they also severely limit the organizational flexibility needed to cope effectively with complex, ambiguous, and unstable task environments. Not surprisingly, a growing number of managers are experimenting with new organizational forms that purportedly achieve flexibility, and thus a degree of reliability under turbulent conditions, by way of more organic and temporary work arrangements (Ilinitch, D'Aveni, & Lewin, 1996). "Hybrid," "network," and "virtual" are several of the terms that have been used to identify these emerging organizing principles.

However, our inductive study of a fire department's use of an approach to emergency or disaster management called the incident command system (ICS) points to the possibility of new, highly bureaucratic and temporary organizational forms able to attain remarkable reliability under a broad range of working conditions, including those marked by extreme uncertainty and instability. An ICS-based organization appears able to capitalize on efficiency and control benefits of bureaucracy, while avoiding or overcoming the considerable tendencies toward inertia (cf. Hannan & Freeman, 1977) usually thought to accompany bureaucratic systems. ICS-based organizations may perform more

We would like to thank David Levine, Marianne Lewis, Suzanne Masterson, and Daniel McAllister for helpful comments on earlier versions. We also would like to thank Kevin Brame and Laurie Meamber for insights offered during the development of our model. Finally, we would like to thank Rita McGrath and the *AMJ* anonymous reviewers for their invaluable feedback. This research was partially supported by a grant to the first author from the University Research Council at the University of Cincinnati.

reliably under extreme conditions than organizations founded on alternative approaches (for instance, organic systems). They appear able to structure and restructure themselves on a moment-to-moment basis and to provide members with means to oscillate effectively between various preplanned organizational solutions to the more predictable aspects of a disaster circumstance and improvised approaches for the unforeseen and novel complications that often arise in such situations.

We organized this article as follows: First, we describe the ICS and provide a brief history of its initial development. We also offer an account of some of the ways ICS-based organizations exhibit flexibility. Then, we detail the inductive procedures used to develop the ICS model. Next, we present our theory, which centers on three main ICS factors—structuring mechanisms, organizational support for constrained improvisation, and cognition management methods—that, in combination, lead to exceptional organizational reliability under volatile environmental conditions. Subsequently, we discuss the potential for generalizing from the fire department's emergency management system to other more mainstream organizations and how our findings compare with current research on new organizational forms and organizing processes.

THE INCIDENT COMMAND SYSTEM

The term "ICS" is the official designation for an approach used by many public safety professionals, including firefighters and police, to assemble and control the temporary systems they deploy to manage personnel and equipment at a wide range of emergencies, such as fires, multicasualty accidents (air, rail, water, roadway), natural disasters, hazardous materials spills, and so forth. The ICS was originally developed through a cooperative effort among a number of federal, state, and local governmental agencies made in response to the harmful disorder that occurred among various organizations, including municipal and county fire departments, the California Department of Forestry, in the state government, and the federal government, attempting to suppress massive wildland fires in California during the 1970s. It represented a significant departure from previous large-scale emergency management methods.

Although initially developed in response to problems associated with wildland fire fighting, the ICS evolved into an "all-risk" system supposedly suitable for almost any type of emergency (such as natural disasters, riots, and terrorist attacks) and for emergencies of nearly any size, ranging from a minor incident involving a single small team, such as a fire engine company, to a major event involving numerous agencies. Consequently, the use of fundamental ICS principles has expanded rapidly. For instance, the ICS was adopted by the National Fire Academy as its standard for incident response. Federal law now requires the ICS to be used for management of hazardous materials emergencies. Many states have adopted the ICS as their model for responding to all types of incidents. Finally, the ICS is a cornerstone of the Federal Emergency Management Agency's Integrated Emergency Management System (IEMS). The IEMS has the objective of developing and maintaining a credible, nationwide emergency management capability involving all levels of government and all types of hazards.

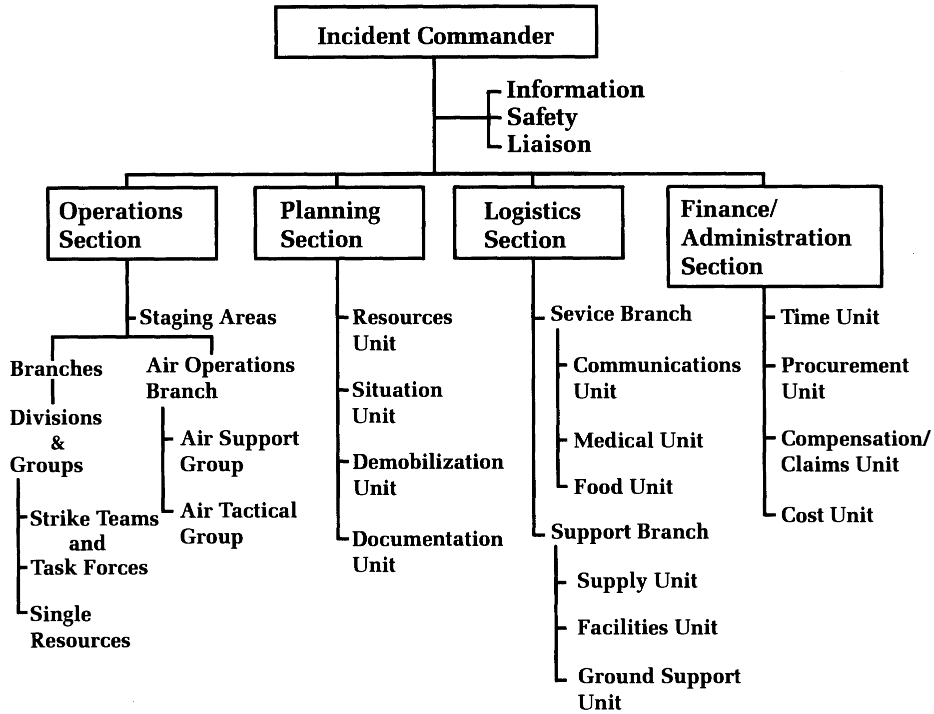
ICS Structure

The basic structure of a fully elaborated ICS appropriate for large-scale emergencies or disasters, such as massive wildland fires or powerful earthquakes occurring in highly populated areas, is shown in Figure 1. Table 1 defines major ICS elements. In the abstract, the ICS appears to exhibit many of the hallmarks of bureaucracy identified by Weber (1947). The system is highly formalized, characterized by extensive rules, procedures, policies, and instructions. Jobs within the system are specialized, are based on standardized routines, and require particularized training. Positions are arranged hierarchically and related to one another on the basis of formal authority. Basic system objectives and plans are established at or near the top of the hierarchy and used as bases for decisions and behaviors at lower levels.

In general, the ICS is constructed around five major functions: command, planning, operations, logistics, and finance/administration. These building blocks purportedly apply in both routine and nonroutine situations and for ICS structures of all sizes. According to ICS logic, even when a system is very small, involving as few as two individuals, all five elements are likely to be relevant to some extent. When the system is small, however, one person may be able to manage all five elements. Large-scale incidents usually require that components be relegated to their own "sections," each of which can be managed separately. In addition, a section can be divided into smaller functions as needed.

Incident commander is the highest-ranking position within the ICS and the one functional position always filled. The person occupying this position is ultimately responsible for all activities that take place at an incident, including the development

FIGURE 1
Incident Command System[a]



[a] Adapted from two 1999 publications: California's *Fire Service Field Operations Guide* (ICS 420-01) and *IS 195—Basic Incident Command System* (Federal Emergency Management Agency: *http://www.fema.gov/EMI/is1951st.htm*).

and implementation of strategic decisions and the ordering and releasing of resources. Up to four sections report directly to the incident commander. The *operations section* is responsible for the development and execution of all tactical operations directly related to the primary goals and objectives of the ICS. The *planning section* develops the action plan to accomplish the system's objectives. It collects, evaluates, and disseminates information about the development of the incident and status of resources. The *logistics section* provides facilities and services to support ICS personnel. The *finance/administration section* provides accounting, procurement, and cost analysis. Finally, in addition to these four primary activities, the incident commander has responsibility for several other important functions, including release of information to external constituents, safety of personnel, and liaison to assisting agencies. Again, the incident commander may find it necessary to delegate authority for performing these functions to others.

ICS Flexibility

Though highly bureaucratic, the incident command system seems to serve as the basis for the exceptional organizational flexibility required for reliable performance under highly variable and risky circumstances. Consider the account of the rapid coordination by the ICS of diverse resources in response to an immense California fire. The event spanned ten days, and the fire was fought under volatile conditions both over treacherous or difficult-to-access wildlands and in various residential areas. From the outset, resource deployment proceeded at a torrid pace. Three minutes after the first call was received, approximately 65 people, 7 engine companies, 2 water-dropping helicopters, and 1 bulldozer were dispatched to the scene. Within 80 minutes, the deployment had escalated to over 950 people and several hundred pieces of equipment. In the end, approximately 839 engines and 44 aerial units (consisting of both helicopters and fixed-wing aircraft) were called into service. Firefighters responded from 458 fire agencies across 12 states and ultimately numbered more than 7,000. Furthermore, as the incident evolved, the dimensionality and uncertainty of the task environment increased substantially. Although fire suppression was the original focus, other operational imperatives rapidly emerged, including search and rescue, medical aid, residential evacuation, and hazardous materials containment. Moreover, personnel from many other types of agencies

TABLE 1
ICS Structural Components[a]

Component	Definition
Section	Organizational level where the major ICS activities (command, planning, operations, logistics, and finance/administration) are managed. The section is located between branches and the incident commander. A section is managed by a chief (such as the operations chief or logistics chief).
Branch	Organizational level located between sections and divisions and having either functional or geographic responsibility for major parts of incident operations. Branches may be activated to resolve supervisory span-of-control issues, or they may be used to subdivide the organization according to disciplines (fire, police, medical aid, and so forth), major operations (such as air), or governmental units (local, state, federal). A branch is managed by a branch director.
Divisions	An organizational level responsible for operations within a defined geographic-type area. Divisions are established to define the incident and help maintain reasonable spans of control for supervisors. For example, the area of a wildland fire may be divided into two, three, or more divisional areas. The floors of a burning high-rise building may be designated as divisions. Divisions are on the same organizational level as groups (see below). A division is managed by a division supervisor.
Group	An organizational level responsible for a specified functional assignment. Examples of groups include fire suppression, search and rescue, and evacuation. Groups can operate across divisional areas and are considered to be on the same organizational level as divisions (see above). A group is managed by a group supervisor.
Strike teams	A collection of resources of the same size and type (such as fire engine companies and fire police patrol units) managed by a strike team leader.
Task force	A combination of single resources assembled for a particular operational need and managed by a task force leader.
Single resource	An individual, a piece of equipment and its personnel complement, or a team of individuals who report to an identifiable supervisor.
Unit	An organizational element having functional responsibility for a specific incident planning, logistics, or finance activity.
Facility	An officially designated area at which a major organizational activity takes place. There are three main ICS facilities: The *incident command post*—The location at which the primary command functions take place. The incident commander oversees all incident operations from the incident command post. The *base*—The location at which primary service and support functions are coordinated and administered. The base may be co-located with the incident command post. The *staging area*—Location at which resources can be held while they await assignment.

[a] Adapted from two 1999 publications: California's *Fire Service Field Operations Guide* (ICS 420-01) and *IS 195—Basic Incident Command System* (Federal Emergency Management Agency: *http://www.fema.gov/EMI/is1951st.htm*).

(for instance, law enforcement, Red Cross, city and county governments, National Guard, Federal Aviation Administration, and Federal Emergency Management Agency, for example) became involved with the emergency management effort, and their diverse contributions were coordinated through the ICS.

ICS-based organizations can coordinate diverse resources to achieve specific objectives under turbulent, severely time-constrained and hazardous conditions. Yet, despite its increasingly widespread use, its attractive qualities (for instance, flexibility, adaptivity, and reliability), and its apparent suitability to a broad array of organizational contexts, the ICS approach has not been the focus of much social science research. Our inductive study of a large California fire agency begins to address this dearth.

METHODS

Research Site

The large county fire department that served as the site for this research is a cooperative venture of the county government and a number of constituent cities that contract with the county for fire department services. Cities in the county either support their own fire departments or obtain fire services through a partnership arrangement with the county. The county fire department serves a population of over 1.2 million. Its jurisdictional area covers more than 560 square miles and consists of urban, industrial, and watershed lands in both city and unincorporated areas. Sixty-plus fire stations are located in three major geographic divisions established for the northern, central, and southern areas of the county. Each division consists of two or three battalions, and each battalion, in turn, is comprised of seven or eight stations. In total, the fire department employs over 800 full-time firefighters and 700 firefighters who are paid for each call.

Data Collection

Data collection took place at the fire department's headquarters and at two fire stations where call volume was exceptionally high and varied, enabling the first author to observe the system in action under different types of performance conditions and conduct interviews with people having considerable experience with the ICS. Data collection occurred in three phases and followed the tenets of theoretical sampling (Glaser & Strauss, 1967; Strauss & Corbin, 1990). Theoretical sampling involves a progressive tightening of focus over the course of a data collection effort on concepts and themes gaining relevance in an emerging model of the phenomenon of interest. Our initial focus was quite broad. We were interested in how firefighters maintain reliable organizational functioning in various risky and volatile emergency situations. As the research progressed, we became increasingly focused on the features of the ICS.

Phase 1 involved collecting data through unobtrusive observation, unstructured interviews, and reviews of various types of written material. The first author rode with engine companies as they responded to emergencies. (An engine company is a small team, usually consisting of a captain, an engineer, and two firefighters, operating a fire engine and responding from it.) Concurrently, the first author conducted unstructured interviews with firefighters, asking them to clarify and expand upon what he had witnessed and to comment on their experiences in other emergency situations. Handwritten notes of observations and interviews were taken in the field. In addition, archival sources of data, including training manuals, field operations guides, and after-incident reports were analyzed.

During phase 2, data were collected through 15 semistructured interviews conducted privately and face-to-face by the first author. To insure that a wide range of perspectives on the ICS was represented, we sought to include in our informant set people who had worked in various fire department and ICS positions and who possessed different levels of training and experience. Therefore, individuals who had held positions such as incident commander, strike team leader, and frontline firefighter were interviewed. Furthermore, informants ranged from veteran battalion chiefs certified in numerous specialty areas (such as paramedic practice, hazardous materials handling, and urban search and rescue) to rookie firefighters.

Interviews were tape-recorded. The average length of an interview was approximately 1.6 hours. Interviewees were first asked to provide demographic information and brief professional and educational histories. Then they were asked to describe situations in which they were involved where the ICS functioned particularly well or intelligently. With an interviewee's answer to this question in mind, the first author asked a series of queries intended to elicit responses helping to further identify and clarify factors that either help or hinder effective ICS functioning. Next, the informants were asked to describe a situation in which the ICS did *not* perform well. Again, specific follow-up questions depended on initial answers.

In phase 3, the first author conducted ten more private, face-to-face semistructured interviews with new informants. All interviews were tape-recorded, and they averaged about 2.4 hours. The primary objectives were to address theoretical gaps remaining after the analysis of phase 2 data and to insure variables and categories were theoretically saturated—that is, that they were at the point where no new or relevant information was likely to emerge regarding the main theoretical constructs (Glaser & Strauss, 1967). After answering standard questions regarding their demographic characteristics and backgrounds, informants were again asked to recount incidents in which the ICS performed both well and poorly. However, in light of the principles of theoretical sampling, many of the follow-up questions were focused much more specifically on aspects of the emerging model.

Analysis

We fully transcribed the Phase 1 field notes and the 25 tape-recorded interviews conducted during phases 2 and 3. Detailed analyses of transcripts and archival materials were carried out both during and after each phase of data collection. We followed a grounded theory methodology (Glaser & Strauss, 1967; Strauss, 1988; Strauss & Corbin, 1990) to develop the conceptual model. Conceptual categories and the relationships among them emerged through an iterative process involving the various data, the developing theory, and the organizational science literature. Throughout the data collection process, we provisionally identified concepts and relationships from the data that seemed pertinent to the emerging model. These ideas were compared to existing research and new data to determine whether initial inferences should be retained, modified, or dropped. Similarly, we kept, revised, or discarded concepts from the literature depending on whether and to what extent they found support in the data.

ICS FACTORS LEADING TO ORGANIZATIONAL RELIABILITY

The construction and maintenance of a coherent response to an emergency situation, such as the California wildland fire discussed previously, represents a considerable accomplishment. The organizational approach must continually map to the requisite variety of a dynamic and risky situation. The system in use must be able to expand and contract, change strategic orientation, modify or switch tactics, and so forth, as an incident unfolds. Compounding the challenge are hazardous task contingencies that may not have been previously experienced or predicted. Furthermore, system and task complexities coupled with the need for immediate local adjustments may preclude the possibility of adequate or timely direction from superior hierarchical positions (Weick, 1990). Yet uncoordinated activities can drastically increase participants' hazard exposure. Finally, many or most system members may have never worked together before and may have the realistic expectation of never working together again.

The data analyses pertinent to this research yielded three major conceptual categories leading to reliable ICS performance under these sorts of hazardous and dynamic emergency situations: structuring mechanisms, organizational support for constrained improvisation, and cognition management methods. Figure 2 depicts our basic framework, which we explicate below.

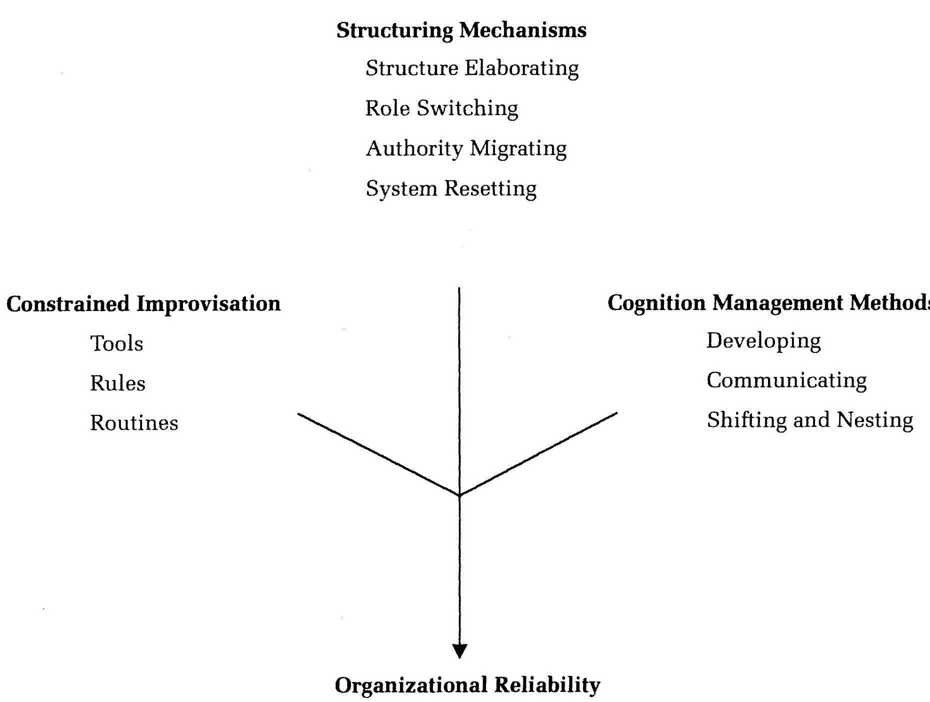
Structuring Mechanisms

The ICS approach, as employed by the fire agency we studied, consists of at least four basic processes for rapidly altering formal organizational structure. We called them structure elaborating, role switching, authority migrating, and system resetting. Their appropriate use depends largely on the specific task requirements encountered by an organization at any point in time. Our analysis indicates that when these processes are aptly applied, organizational flexibility and reliability are enhanced.

Structure elaborating. Structure elaborating denotes the highly specified and fundamental processes of organization construction. The ICS places considerable emphasis on methods of system assembly for several reasons. First, an ICS-based organization is typically built at the scene. Additionally, these systems must be capable of rapidly organizing a few to several thousand people under demanding circumstances. These design requirements bring organizing processes themselves to the fore. The ICS structure elaboration process is well developed, with the initial construction of all ICSs commencing in approximately the same way. A battalion chief described the process:

> That first unit in is the incident commander regardless of who it is or what it is. . . . He's going to arrive on the scene; he's going to give his report on conditions; he's going to report resources. He's going to do what an incident commander does, for the initial stages of it. And then as this thing starts to build, and you have other people coming in of higher rank or higher positions, he may get bumped way down

FIGURE 2
ICS Factors Leading to Organizational Reliability in Complex and Volatile Task Environments



into the system, but at one point he was running the show. And all incidents start the same way. They start with the first unit on the scene. And they start building.

Another battalion chief described the process for a large and complex incident:

They [incident commanders] go through the risk assessment deal, the communication of objectives, and the assignment of resources. Then they start going through those standardized tools and start putting some organization to it, it becomes more like things we have done before. And with the pattern people accept the leadership roles, they accept the organization, and start to function within it. Then it gets you moving down the line. . . . And then at some point in time you're going to have enough fire resources, or emergency resources, or cranes, or whatever else you need in place so you can start now to whittle away at this emergency so it's not an emergency anymore.

The captain of the first unit to arrive usually becomes the incident commander and has at his or her disposal the basic organizational building blocks discussed previously (see Figure 1 and Table 1). The incident commander assesses the situation, identifies contingencies, develops objectives, ascertains resource needs, and generates an initial action plan. Then he or she begins to build an organization by assigning roles and tasks to incoming resources.

Informants reported that the ICS works best when the various ICS roles or positions are filled with people only to the extent required. In most instances, only the operations section (see Figure 1) is activated, and then only at single-resource, task force, or strike team levels. Furthermore, while the five major ICS activities (command, operations, and so forth) are carried out to some degree at all incidents, they often are not assigned to specialized roles. In fact, the overdevelopment of higher-level components, such as sections, branches, and divisions, can compromise system effectiveness, as a battalion chief indicated:

I'll tell you where it doesn't work. And I guess I know this has happened. You get some people in the incident command system, the first thing they start doing is they start filling in bodies in all the boxes. "I'm the incident commander. I need operations, plans. . . . I'll just fill in the boxes." And there's nobody left to put out the fire. . . . They don't have any resources because they've used them. They've got an operations chief, and they've got a division supervisor here, a division supervisor there. And they've got this guy here and that guy there. And then they say, "Anybody got a line on the fire?" That's not using the incident command system as designed. . . . I go in, I've got my hat on. I'm the incident commander. I'm also the operations chief, also the division supervisors. And until that thing gets big enough to where I'm dividing it, I wear all those hats.

The structure-elaborating process may persist until the emergency begins to abate. Within the most reliable systems, objectives and corresponding structural elements and relationships are adjusted swiftly in accordance with changing environmental contingencies. In fact, we noted that an incident commander's goals and plans might be revised completely, over the course of minutes or hours, depending on the evolution of a particular situation. A battalion chief describes how an organizational approach had to be altered frequently to combat an enormous wildland fire threatening numerous residential properties:

We would put up lines of defense that the fire would blow through like nobody's business. So we had to constantly reevaluate our strategy. I think you've seen in our command development, normally we will come up with a set of incident objectives we'll communicate to the troops. And 90 percent or better of the time that set of objectives is highly successful and stops the emergency. We developed seven sets of objectives that kept getting their butt kicked during the ______ fire. And each time we lost a strategy, we had to pull out a map, write off more houses, think about the evacuation thing again, and try and beg more resources.

Role switching. Role switching complements the structure elaboration processes. ICS roles are activated and role relationships are established in accordance with the functional requirements of a situation, as assessed by the incident commander. Positions are also deactivated when goals and plans no longer require them. Role switching involves the reassignment of personnel to different positions within the organization. Whenever the appropriate role structure for an emergency situation changes, personnel are either moved into newly created roles or discharged. Given that well-defined expectations and reporting relationships are attached to ICS roles, transferring individuals among roles represents a fairly efficient way of reorienting them to evolving conditions. A captain discussed a situation in which role switching was required:

Okay, initially, we arrived at the scene [of a structure fire] and I established command and assigned people to different divisions: an interior division and a roof division. Once we had the system established, we sent somebody in for interior. Then, I get a report back that we have a hazardous materials incident. So, we pull all our people. Now the incident command structure changes slightly, where

> now we have to think in terms of hazardous materials. It went from what we call an incident command on a single family structure fire to a hazardous material incident. There is a whole different set of strategies and a different set of names for what you want people to do next. Before we were talking about interior division and roof division or ventilation division. Now we are talking about hazmat group, exposure group. . . . Same people with others added.

Authority migrating. Critical expertise for solving problems associated with a particular situation is often distributed within an ICS (Flin, 1996). For instance, individuals may have specialized training or considerable knowledge in areas such as construction or chemical processing by virtue of holding second jobs. Informants repeatedly suggested that although formal authority relationships are fixed, informal decision-making authority, especially at the tactical level, can become explicitly decoupled from the official hierarchy and migrate quickly among ICS positions to individuals who possess the expertise to solve particular problems. Roberts, Stout, and Halpern (1994) described a similar phenomenon that occurred on two nuclear-powered aircraft carriers, whereby individuals of superior rank tended to defer to lower-level experts who were more technically qualified when decision-making errors could have catastrophic consequences. Informants reported the ICS works best when supervisors permit and direct authority migration. An engine company captain provided an example of the authority migration process in an ICS:

> As a manager, it is really incumbent on me to recognize my weakness [in a particular area] . . . and that I don't have as much knowledge as maybe a guy standing here next to me. Maybe I've got one of the premier national USR [urban search and rescue] truck captains standing next to me, and this guy knows it like bread and butter. So I'd be a much better manager, and I'd basically build the trust of people better, if I said, "Okay, here's what the overall goal in this incident is: to get this truck off this guy. Okay? And Bob over here on Truck 45, or whatever, is the one that's going to basically direct the point-by-point operation of this." You know, because this is the guy that has the knowledge. So you bring in the experts. You bring in the guys that have all the tools and the knowledge, and you let them handle that end of it, and you still manage to hold the scene. You know, you're not relinquishing command of the whole thing. You're not relinquishing your position. You're basically using your resources to the best of your ability, and he's one of your resources.

System resetting. In cases where an initial strategy seems to have no effect or the system is confronted with a "nasty surprise" (for instance, an explosion of flammable materials that had not been previously identified) that calls into question the current approach, the incident commander may opt to completely disengage the system from its task environment and redirect or reconfigure it. Disengagement is ideally done in an orderly and rapid manner under existing reporting relationships. A battalion chief explains how this option was used after an unexpected explosion occurred while firefighters were trying to extinguish a fire in a garage:

> Things didn't go as planned. That fire should have gone out, and all of a sudden it's running at you. . . . It took a turn of events that was unexpected. And they will do that to you. Some of them will go like clockwork. Some of them will take that turn of events. And in a situation like that, that's a "fall back and regroup." You're not going to get anybody hurt. You all back out. We had a couple of guys that got a couple of small burns and things because of the turn of events. But nobody was hurt seriously. But you fall back. And what happened is, you know, maybe you take a defensive posture now. Instead of an aggressive going in and putting it out. You go back and say, "What do we have." And maybe we let it burn, and we save the surrounding structures. It can change your whole tactic. So it's a fall back and regroup. What happened, and do we know why? If you know why, then you can change your plans.

Our discussion of structuring mechanisms in this subsection highlights the modularity of the ICS-based emergency management organization we studied. A system is modular to the extent that its components can be separated and recombined in various ways while system functionality relative to environmental demand is maintained or enhanced (Schilling, 2000). In general, these structuring mechanisms represent a fairly explicit set of procedures for assembling and reassembling various organizational elements or modules into a variety of configurations as a response to changing conditions.

Support for Constrained Improvisation

According to informant comments and our observations, the explicit procedures for altering the formal structure do not, in themselves, provide the full measure of flexibility required for an ICS-based organization to respond effectively to many multifaceted, volatile, and hazardous task environments. In general, complex and dynamic systems are not fully comprehensible to their members (Asch, 1952). The incident commander (and other supervisors) may not understand enough about the contingencies of situations facing subordinates to provide sufficient direction, especially if the commander is somewhat removed from the actual field of activity. In addition, because each emergency is, to some extent, unique, task demands can outstrip the experience base of ICS personnel. Finally, decision errors made at the top of the hierarchy can ramify and intensify as they move down the authority structure, resulting in an increasingly hard-to-understand and dangerous situation (e.g., Turner, 1978; Vaughan, 1996).

To reduce the problems of explicit and centralized structuring, incident commanders and other supervisors possess considerable discretion regarding the extent to which they give detailed instructions to subordinates. When a commander believes subordinates possess sufficient experience, training, and resourcefulness to adapt to local conditions, he or she typically leaves the task partially unstructured (unless an unusual degree of directed coordination is required for some other reason). In other words, supervisors provide subordinates with a degree of latitude to improvise—that is, to activate and coordinate their own routines and to apply novel tactics to unexpected problems. This improvisation represents an implicit or bottom-up structuring process. A truck company captain described the basic nature of improvising:

> Improvising is altering your tactics or your methods to still accomplish the same goal with an understanding of what the connection [between the altered tactics and the goal] is.

Another captain, an assistant fire-training officer, suggested the following definition:

> Improvising is still accomplishing the same task, but maybe not doing it specifically as it's outlined in the book.

In addition, improvisational acts spring from, and tend to be limited by, at least three distinct bases: tools, rules, and routines. A truck company captain described the improvisation that takes place frequently with *tools:*

> We improvise all the time because we only have so much stuff on the trucks and when we get to the scene, we're expected to handle the situation with what we have on the trucks, so we improvise. . . .

In other cases, improvisation may involve more radical departures from the status quo, such as adopting tactics that directly contradict standard operating procedures. In these cases, individuals improvise with reference to the *rules*. Most informants provided examples of cases in which violations of standard operating procedures were necessary. For instance, a firefighter reported that one standard operating procedure prohibits "opposing hose streams"—different teams of firefighters are not supposed to approach a fire from directly opposite positions because one group can push the fire into the other. However, he discussed a situation in which his company effected a rescue in conjunction with another company using opposing hose streams as a primary tactic. The degree to which an individual can engage in tactics that transcend or contradict standard operating procedures is a function of his or her experience level. A captain stated:

> Every incident is dynamic, and so every incident may require a different approach. If you absolutely have to do something contrary to standard operating procedures, that will be based on a decision that the commanding officer makes on the basis of his or her experience or outside knowledge—knowledge that maybe isn't a regularly trained activity within the department. . . . A good example would be . . . an engine company captain who has hazardous materials training to a higher level. . . . He may be able to base many decisions on just a higher level of training or higher level of expertise and so he may react a little different to the situation than say for example, a company officer who didn't have that level of training.

Finally, ICS members improvise with regard to the execution and coordination of their *routines*. Standard routines, such as hose laying or ladder throwing, may have to be adjusted to accommodate local circumstances. Furthermore, the coordination of routines among companies may require improvisation. As resources arrive at an incident, they are assigned to particular tasks. At a building fire, for example, an engine company may be directed to enter the building and start firefighting, and a truck company may be given the job of ventilating the structure. As a building burns, substantial smoke and heat can accumulate in its interior. Without proper ventilation, the firefighters assigned to attack the fire from within the building may be at considerable risk, because smoke reduces visibility and heat buildup can result in spontaneous combustion. Teams such as these may have to coordinate their activities in unusual situations, such as when building construction is peculiar.

Importantly, improvisation is considered legitimate and supported only to the extent that it fits with extant organizational goals and is not likely to cause harm to the improviser or anyone else. Otherwise, it is overtly discouraged. The (derogatory) term used to describe illegitimate improvisation is "freelancing." Freelancing refers to behavior not directed at, or supportive of, ICS goals, objectives, and approaches at a particular incident. Freelancing can severely increase the hazard potential of an operation for those involved. An engine company captain described one example of freelancing:

> We'll get an engine pulled up in the front of the house, and they take an interior attack line through the front door. They're inside. The place is not ventilated well yet so the smoke level is way down, you know. Pretty, fairly explosive environment inside. They're trying to put the fire out. Well, basically, all that heat's in there, and then you get a unit that comes like from the side of the house or the back of the house. It doesn't know what the unit in the front is doing, and then these guys just basically stick a line through the window and open it up. Well, that disrupts the whole thermal balance of that interior structure and all that heat goes to the floor, and now your firefighters are inside the house on the floor, so that heat comes down and steams them.

In sum, appropriate improvisation with tools, rules, and routines augments contingent structuring mechanisms, thereby enhancing organizational resilience and responsiveness. The detailed pattern of behaviors occurring within an ICS at any point in time is a consequence of the interplay between relatively centralized and explicit structuring and more diffuse local accommodation and improvisation. The ICS must achieve a balance between, and resolve the tensions associated with, more preplanned and imposed versus more spontaneous and emergent task-structuring activities. Our research suggests ICS cognition management methods provide a means that help resolve the tensions.

Cognition Management Methods

Our analysis suggests that the degree to which the organization we studied was able to effectively coordinate behaviors emanating from the more top-down (versus bottom-up) structuring processes described in the two preceding subsections depends largely on the extent to which organization members are able to build and maintain viable understandings of the activity system to which they belong (see also Weick et al., 1999; Weick & Roberts, 1993). These understandings represent the basic cognitive infrastructure permitting individuals and groups to effectively integrate their behaviors with those of others on a moment-to-moment basis as an incident unfolds and evolves. Attention to these understandings, or "operational representation" is, therefore, critical to the appropriate activation and balance of explicit and implicit structuring processes.

We use the term "operational representation" to denote individuals' perceptions of an organization (including their places in it) and its environment, the comprehension of the meaning of these, and the projection of their status into the near future (Endsley, 1997). High-fidelity and shared mental models help members of high-reliability systems coordinate their own behaviors and solve problems presented by complex and fluid task environments (Roth, 1997). However, a number of factors tend to limit, fragment, and create discrepancies among operational representations. For instance, at the individual level, the cognitive limitations of human beings preclude the comprehensive representation of a complex activity system by any of its participants (Asch, 1952; Simon, 1976). Moreover, individual differences in backgrounds and intellects can affect the content and quality of different people's interpretations of the same situations. For instance, rookie firefighters can have extreme difficulty in comprehending emergency situations due to their lack of experience with them.

In many organizations, several elements cause further divergences among system understandings. For example, organizing strategies employed to compensate for individual-level deficiencies, such as the division of labor, tend to fragment situational assessments because people are given different responsibilities for representational content (Hutchins, 1995). Individuals are also placed in various geographic and social locations within their organizations. Consequently, members are exposed to different stimuli, learning idiosyncratic "facts" as they construct situational meanings and mental models (March & Simon, 1958).

The general problems that organization members have in constructing shared operational representations are exacerbated in ICS-based organizations. Structuring processes in these organizations are continuous and typically more intense and pervasive than in more permanent organizations. Since the task structure of the system is often in a constant state of flux, the assessments held by members cannot be finalized at any point in time. Furthermore, as a system becomes larger and more elaborate, fewer and fewer of its emergent properties are likely to be held in the mental model of any one individual (Weick & Roberts, 1993). As a result, evolving, discrepant, and disconnected representations can become more and more widely dispersed across the system in a short time period.

In the fire department we studied, several factors countered the forces discussed above. Our analysis suggests that ICS-based firefighting organizations possessing the greatest potential for flexibility are those in which the most attention is given to developing, communicating, and connecting individuals' understandings. Firefighters regularly use the term "size-up" to describe *developing* operational representations. An engine company captain described size-up:

> We call it size-up. What's going on? What's the time of day? What's the wind, weather like? What are the traffic conditions? What type of building are we going to? What type of engine? And then what is it when we get there? We have this picture of what's happening. We constantly evaluate that. We're supposed to constantly evaluate what is going on to see if we have to make any changes.... It's an ongoing picture. It's an ongoing process. We are constantly evaluating it. My wife gets mad at me because I do this at home.

Developing these types of representations can be an effortful accomplishment on the part of system participants. Furthermore, representation construction is typically initiated immediately upon receiving a call. An engine company captain discussed the size-up process:

> I start building a picture as soon as I'm dispatched. I start thinking of the neighborhood, what's in that neighborhood, what kind of houses we have—big houses, little houses. If it's an industrial area, what chemicals they have. I certainly start the size-up of it as soon as I read the dispatch. We do the size-up right away.

For ICS participants, operational representation is the outcome of a process that relies heavily on intense *communicating*. The communication of accurate and timely representational information is critical to the early stages of system development. The initial size-up provides the context within which objectives are formulated and roles activated. Additionally, in the case of a large incident, such as an immense structure or wildland fire, the first incident commander is usually a company captain who will likely transfer command to a higher-ranking and more qualified individual. To facilitate a smooth handoff of command and insure that incoming personnel can efficiently coordinate their activities with the evolving system, the first incident commander is required to communicate his or her size-up of the situation, as is described in the following dialogue:

> Battalion chief: He gives me a report on conditions. He's painting a picture. He's painting a picture on the radio. He gives it on the radio. Let's just say it's engine 21. "Engine 21 is on scene. I have a two-story single-family residence." Right away you've got a picture of a two-story single-family residence. "I've got smoke and fire showing out of the back south corner." You know on your map where that is. You've got a pretty good idea. He's painting a picture telling you what you have.
>
> Interviewer: And you know when you show up how you will relate to everybody else?
>
> Battalion chief: Hopefully. That's the whole purpose of painting the picture. And that's part of what we do. You have to give a report on conditions. And you're painting the picture not only for the battalion chief coming in, but also for all those other units that are coming in. They're going to have a pretty good idea of what they've got before they get there. That's real important.... I guess, the decision-making process starts before you get there. You start thinking about this. You've got the picture painted. What do I got? This is what I've got. When you get in there you're not surprised. If you are surprised, somebody didn't do his job right.

Several of the structuring mechanisms discussed previously produce outcomes (objectives, goals, roles, and so forth) that present system participants with consistent cues around which similar meanings can be constructed. For instance, the designation of an incident as a structure fire or a wildland fire with the specific objective of saving a life or preserving property provides common representational elements. A battalion chief discussed how the ICS provides an orienting function in a wildland fire situation:

> We were up there eight days, and when we first got there, the fire had burned somewhere around, I'm going to estimate, 70,000 acres. The incident command system at that time was developed to the point to where it had not only an incident commander to operations, but the fire also had four branches. Those branches were divided into about 20 divisions, and then those divisions were further divided down into the strike teams. It [the ICS] organized it so that everybody that had a part in the fire worked together so that they all had the ultimate goal of to knock this thing down and put it out. So, regardless of your part in the fire, you knew that with what you were doing, with what somebody else was doing, it was organized before you even went out there....

Despite the attention to communication of representations, perspectives on the system can remain divergent and disconnected. One main reason for this is that the cognitive or perceptual requirements of particular tasks can be so demanding that individuals performing them are not able to maintain an awareness of the surrounding system. For instance, the tasks of ventilating a burning structure by cutting a hole in its roof or extracting an individual from an automobile using the "jaws of life," require individuals to tightly focus on specific tasks. Few cognitive resources may be left over for the situational awareness required for mutual accommodation. A firefighter explains his representation of the situation:

> I'm not overly conscious of what they're doing because I'm involved with the roof [that is, cutting a hole in it]; I could fall from the roof. And I'm concentrating on my own job and getting what he [the incident commander] wants done. My productivity. But I am cautious of who is down there [in the building] and how many . . . that I know. Did I get them [that is, drop part of the ceiling on them] or didn't I get them.

The exceedingly narrow system representation produced by this type of circumstance is addressed by *shifting* representational responsibility to others. When the nature of a person's task is such that he or she cannot maintain a viable operational representation, that person's representational responsibility is off-loaded to another ICS participant who is in a better organizational position and possesses sufficient cognitive resources to build and maintain an understanding of the activity system. The second person helps to insure that the first person's behaviors maintain coherence with those of others in the organization.

Representations also involve a sort of *nesting* in terms of scope and detail. Nesting frequently follows lines of authority. In the situation discussed by the firefighter in the previous example, his captain would be the individual most likely to be responsible for maintaining the perspective necessary to insure that the firefighter's activities were sufficiently integrated with those of others in the system. The hierarchical process is suggested by the following comments regarding the major representational concerns of progressively higher-ranking individuals in an ICS:

> Firefighter: This saw is going to need a new chain. I'm running low on my fuel because I know how long I can last on a tank of fuel in my chain saw. This ladder is too close to the fire. Just stuff like that at my level.

> Truck company captain: I'm thinking about what equipment I'll be needing a little bit later, or manpower, or in keeping ahead of it. And that way I can order it prior to needing it. You don't want to order things when you need them because you're behind. As a firefighter, it's pretty much task-oriented. I think they're pretty much zoomed into cutting a hole, doing that, doing it in a safe way, and waiting for more instructions.

> Battalion chief, as strike team leader: I have the big picture over my strike team, over what they're doing. I have that overall picture, and I report to a division supervisor. And then he has the overall picture of that whole division. He reports to a branch. That branch has the overall supervision picture of that branch. They all report to the operations chief who has the overall picture of the whole thing. . . . But what I'm actually responsible for is not the big overall picture, it's the picture of my assignment.

The incident commander is designated as the individual who attempts to maintain the "big picture" of the operation. Terms, such as "having the bubble" (Roberts & Rousseau, 1989) and maintaining "situational awareness" (Endsley, 1997) similarly denote "the integrated big picture of operations in the moment" (Weick et al., 1999). Rochlin described the notion of having the bubble in U.S. Navy combat situations:

> Those who man the combat operations centers of US Navy ships use the term "having the bubble" to indicate that they have been able to construct and maintain the cognitive map that allows them to integrate such diverse inputs as combat status, information sensors and remote observation, and the real-time status and performance of the various weapons and systems into a single picture of the ship's overall situation and operational status. (1997: 109)

If the incident commander or some other high-ranking member of an ICS is able to achieve and maintain a quality operational representation, the system is more likely to be able to match environmental demands and forestall catastrophic system failures. Quality operational representations increase the potential of commanders to effect both small adjustments and major reorganizations when necessary.

According to Weick and Roberts (1993), the capacity for system flexibility is enhanced to the degree that overlapping representations can be established and maintained among system members. ICS participants whose operational representations exhibit similarity in important areas (especially the basic situational definition) can work together effectively to achieve a viable balance between explicit and implicit structuring processes. However, given the array of factors potentially impinging on individuals' perceptual and cognitive processes, fragmented and divergent perspectives are likely to arise. In those ICS-based organizations possessing superior response potential, members work hard to establish and update mental models. They also try to shift and nest representations in attempts to overcome the limits on their cognitive resources.

DISCUSSION

This study identified incident command system factors permitting a fire department to respond reliably to dynamic, unpredictable, and hazardous working conditions. The model developed through inductive analysis of observational, interview, and archival data centers on three main concepts: structuring mechanisms, organizational support for constrained improvisation, and cognition management methods. In general, an ICS-based organization works best when distributed operational representations are developed and connected so that suitable (that is, commensurate with the functional requirements of the emergency situation) structures can be deployed and the behavior emanating both from imposed structures and from more local accommodation and improvisation can be coordinated.

Systems constructed at emergency or disaster scenes on the basis of ICS principles have been categorized as high-reliability organizations (HROs; Grawboski & Roberts, 2000). High-reliability organizations exhibit continuous, nearly error-free operation, even in multifaceted, turbulent, and dangerous task environments (Roberts, 1990). Several classic examples of organizations that should be highly reliable are naval aircraft carriers (Weick & Roberts, 1993), nuclear power generation plants (Schulman, 1993), air traffic control systems (Weick, 1990), space shuttles (Vaughan, 1996), and maritime systems (Wagenaar & Groenweg, 1987). Some high-reliability organizations are designed for the express purpose of mitigating crises (such as aircraft carriers); others must be capable of performing under crisis conditions, even though their primary operations are more mundane (such as nuclear power generation). Since some social science scholars have identified the high-reliability organization as an unusual type of organization (Scott, 1994), questions about the generalizability of research on such organizations to more mainstream organizations appear warranted.

High-reliability organizations have been considered unique primarily because of the perception that their failures have much more potential to produce rapid and devastating repercussions than failures in other types of systems (Weick et al., 1999). However, high-reliability organizations and supposedly more conventional organizations have become less distinguishable along this dimension as a result of the previously noted transformations taking place in many organizations' environments. The demanding task situations to which an increasing number of mainstream organizations are exposed have much in common, in an abstract sense at least, with those high-reliability organizations manage. Both are often characterized by substantial complexity, ambiguity, dynamism, risk, and time constraints. As a result, Weick and his colleagues (1999: 82) suggested that high-reliability organizations represent "harbingers of adaptive organizational forms for an increasingly complex environment" and "provide a window on a distinctive set of processes that foster effectiveness under trying conditions."

The idea that the ICS, in particular, may represent a precursor to, or suggest the possibility of, a new organizational approach for difficult conditions is consistent with the observation that basic ICS qualities identified in our study find analogues in recent research on new forms or processes of organizing. We discuss below how the major facets of our model relate to current research on the "copresence" of bureaucratic structure and organizational flexibility, the relationship between structuring and useful improvisation, and the notions of mental models and collective mind in organizations. We conclude this section with a consideration of research limitations and implications for future research and practice.

Bureaucratic Structure and Organizational Flexibility

Our theory emphasizes the role bureaucracy plays in producing rapid structural variation in response to situational contingencies. The possible coexistence in organizations of both extensive bureaucracy (in terms of rules, routines, procedures, and so forth) and exceptional flexibility is suggested by the work of Adler, Goldoftas, and Levine (1999). These researchers studied model changeover events at Toyota's NUMMI (New United Motor Manufacturing Inc.) automobile assembly plant and found that the highly bureaucratized and efficient NUMMI organization is also quite flexible. They identified four mechanisms (meta routines, enrichment, switching, and partitioning) that functioned to shift the typical trade-off between efficiency and flexibility, enabling the NUMMI system to attain higher levels of each concurrently. In a sense, these mechanisms increase organizational flexibility by augmenting and transforming more traditional bureaucratic structures. Similarly, our model identifies features of the ICS, such as variable structuring and support for improvisation, that augment more standard bureaucratic arrangements. However, the theory we develop extends Adler and colleagues' work (1999) by suggesting that basic bureaucratic elements, such as roles and reporting relationships, can serve as important sources of flexibility when they are combined with structuring processes. In this regard, the ICS resembles Ciborra's (1996) "platform organization."

Ciborra (1996) conceived of the platform as a "formative context" providing top managers facing frequent environmental surprises with resources for generating new combinations of structures and routines to produce whatever specific organizational form (hierarchy, matrix, network, and so forth) is required to match current circumstances. Ciborra noted this:

> [the platform] is a virtual organizing scheme, collectively shared and reproduced in action by a pool of human resources, where structure and potential for strategic action tend to coincide in highly circumstantial ways. . . . Schematically, the platform can be regarded as a pool of schemes, arrangements and human resources. . . . In the platform one is continuously confronted with the coexistence of a multiplicity of organizational structures. Flexibility is achieved in practice by pasting up structures that have a high potential for action in response to chaotic events. (1996: 115)

Ciborra's (1996) platform represents an assortment of activated and latent organizational components (departments, division, functions, and the like may constitute single components for some platforms) from which top managers select and (re)combine elements in accordance with their situated and subjective interpretations of the task environment. Ciborra insisted that such a "metaorganizational context" is not designed. Instead, "it emerges as the result of the managers' situated rationality and actions, while they busily recombine those very arrangements, and artfully operate them" (1996: 115).

The ICS and the platform are similar in that both represent formative contexts containing resources for structural variation. However, the ICS and the platform are distinguishable in important ways. Platform elements and associated structuring processes largely accumulate in a sedimentary manner, with structures and processes building up over time in the practices and cognitive bases of organizational members. Further, little attention is given to discarding platform elements. "On the surface, the platform organization looks as a stable pool of 'junk' resources, 'badly organized' according to efficiency criteria, but ready to be deployed when the technology or marketing strategy requires it" (Ciborra, 1996: 116). In contrast, ICS structures and structuring processes tend to be more deliberately and purposively developed and are codified, to a large extent, in a set of formal procedures. Furthermore, although ICS elements do accumulate, approaches that prove unviable are frequently thrown out. Consequently, the development and retention of structures and processes is more strategic in an ICS than in a platform.

Further, Ciborra's (1996) platform resides largely in the imaginations of the top managers. As a function of an intense training and socialization regime, knowledge of ICS roles, routines, and processes are distributed widely throughout an organization. Thus, the ICS is quite transparent to members. Participants typically possess a general understanding of how the system works and how the various roles they may assume contribute to the larger system. In this regard, an ICS is more of an enabling bureaucracy (Adler & Borys, 1996), perhaps supporting more flexible and adaptive organizational behavior than a platform. Finally, the platform structuring process appears to be mainly top-down, whereas ICS structure is generated through both centralized and decentralized structuring processes.

Partial Variable Structuring and Constrained Improvisation

Several scholars have discussed the idea that partial or underspecified structure is conducive to, and required for, improvisation (Brown & Eisenhardt, 1997; Moorman & Miner, 1998; Weick et al., 1999). For example, Brown and Eisenhardt's (1997) study of firms pursuing multiple product innovations develops the concept of "semistructures." Semistructures are manifest in organizations "where some features are prescribed or determined (e.g., responsibilities, project priorities, time intervals between projects), but other aspects are not. Semistructures exhibit partial order, and lie between the extremes of very rigid and highly chaotic organization. . . . Change readily occurs because semistructures are sufficiently rigid so that change can be organized to happen, but not so rigid that it cannot occur. Too little structure makes it difficult to coordinate change. Too much structure makes it hard to move" (Brown & Eisenhardt, 1997: 28–29).

However, extant models of organizational improvisation highlight the significance of partial structure but do not represent adequate consideration for the type of situation or the potential for detrimental extemporaneous behavior. The theory developed here considers the effects of *variable* structuring on improvisation. It suggests that benefits may accrue to systems able to adjust the degree of task structure experienced by organization members. For instance, when an organization confronts a relatively stable task environment or is made up of less competent individuals, more specific direction to subordinates may yield important efficiency and control gains. Alternatively, when an organization faces a turbulent and unpredictable task environment and consists of skilled, knowledgeable, and resourceful people, latitude for subordinate improvisation may be vital to organizational effectiveness.

In addition, the present research includes an important distinction between more and less potentially useful improvisation. The possibility always exists in organizations for an empowered individual to work against organizational goals and cause confusion and harm to others (Simons, 1995), particularly in extremely fluid situations. Within the ICS-based organizations we studied, social sanctions on freelancing and cognition management methods help insure improvisation is performed with an understanding of, respect for, and deference to the objectives and structure of the extant activity system.

Mental Models and Collective Mind

The current research directs attention to the potential importance of well-developed mental model formation and management methods within organizations confronted by rapidly fluctuating environmental contingencies. In particular, our analysis of an emergency management system indicates rapid structural variation and significant local improvisation can lead to either organizational flexibility or organizational disintegration, depending largely on how well behaviors emanating from explicit and implicit structuring processes are integrated and coordinated. Potential for behavioral integration and coordination is, in turn, largely a result of the integrity of the operational representations that system participants are able to achieve and maintain. Yet, because individual- and organization-level factors conspire to fragment and distort people's understandings, the mental models driving organization-level reliability at the scenes of difficult emergency situations are largely a collective accomplishment. Our analysis indicates the processes of developing, communicating, and shifting and nesting operational representations during implementation of the ICS give rise to a collective representational infrastructure helping to protect individual members against cognitive overload and facilitating appropriate moment-to-moment interrelating of their behaviors. Given the widely acknowledged limits to human cognition, the nature and function of cognition management methods in this and other types of organizations requires much more research attention in the future.

It is worth noting two ideas—that (1) "understanding" or "awareness" can be usefully conceptualized as a group-level phenomenon, and (2) "cognition" occurs not only within individuals but also between or among them, as a function of the quality of the connections or interactions they are able to accomplish with each other—have been gaining currency in organization science research (e.g., Hutchins, 1995; Resnick, Saljo, Pontecorvo, & Burge, 1997; Taylor & Van Every, 2000; Weick et al., 1999). For instance, Weick and Roberts (1993: 366) suggested that collective mind is manifest where organizational members' "heedful" interacting connects distributed task-related know-how in such a way that situational demands are met. From this perspective, a continuous interrelating of activities synthesizes, constructs, or represents a capacity for "comprehension" in collective *action* that no one person could possess in his or her individual mind. People working together heedfully "respond *as if* the complexity of the system in question were understood by the group" (McGrath, MacMillan, & Venkataraman, 1995: 255; emphasis in the original). We argue that cognition management methods, in combination with explicit, partial structuring and constrained improvisation, give rise to the action that is collective mind in fire department emergency management operations.

Limitations and Future Research

The initial goal of our work was to generate conceptually grounded theory regarding how members of a fire department organize themselves to effectively manage complexity, ambiguity, and risk at emergency scenes. Therefore, our framework should be regarded as quite provisional until future research verifies it in similar and other contexts. Further, the theory we present is somewhat abstract. A comprehensive and detailed treatment of such a complex system would go well beyond the scope of a single paper. So, although we attempted to highlight the major ICS qualities that contribute to organizational flexibility and reliability, future research is needed to specify further system elements and more completely establish theoretical boundary conditions. Below, we discuss several factors that may limit the generalizability of the emergent model.

First, the viability of the system we studied appears predicated, in part, on a value system that is clearly defined and almost completely accepted by organization members. Life preservation and environmental protection are essentially unquestioned by firefighters as overarching, legitimate departmental purposes. Similarly, major functions, such as fire suppression, medical aid, and hazardous materials cleanup, receive almost universal support as valid spheres of activity within which those purposes can be pursued. It is likely that such value consensus reduces the severity and occurrence of behaviors such as political acts and power struggles (cf. Pfeffer, 1992) that could disrupt ICS organizing processes. Future research is required to ascertain the extent to which the model is generalizable to contexts wherein fundamental organizational purposes are more ambiguous or contested.

Additionally, the ICS-based organization we investigated possesses a clearly defined and compelling authority system. Those employing explicit structuring mechanisms rely on the authority system to legitimate their directions. Also, the authority system is relied on heavily as a mechanism to resolve disagreement and conflict, with the incident commander being the final arbiter of disputes. To the extent that conventional firms do not possess such salient and potent authority systems, the integrity of an ICS approach might be compromised.

Also, the emergency management organization we studied might not always be constrained in the same ways as more mainstream firms. For instance, in life-or-death circumstances, resource constraints are likely to be relaxed to a considerable degree. In contrast, more conventional organizations can face quite severe resource limitations most or all of the time. Our preliminary work suggests that the highest levels of system reliability (in terms of the capacity to continuously and effectively manage working conditions, even those that fluctuate widely and are extremely hazardous and unpredictable) may depend on commensurate resource allocations. On the other hand, our data do not show that the ICS approach itself breaks down in the absence of massive resource commitments. In fact, it appears more likely that the ICS enhances reliability and flexibility for given levels of resource commitment. As a practical matter, major firefighting operations are frequently "underresourced" to varying degrees, especially during the initial stages of an emergency. The first units to arrive at the scenes of incidents, such as the large California wildland fire described previously, must perform certain functions reliably—that is, without error or miscue—even though equipment and personnel may be abysmally inadequate to manage general working conditions over the short, medium, or long run. In cases such as this, reliability is likely to be more narrowly focused on averting injury while building the infrastructure for an organization capable of managing situational demands once sufficient resources arrive. Future research in emergency management and other contexts is clearly required to more precisely ascertain the relationship between resource level and reliability for ICS-type programs.

Finally, there are other differences between emergency management and more conventional organizations that may impact model generalizability. For example, basic system purposes and preferred outcomes may be more uncertain for many organizations in hypercompetitive environments than for fire departments in most emergency situations they face. Attaining reliability may be increasingly difficult as such uncertainty escalates.

Organizing Temporary Systems for High Reliability

With the above caveats in mind, we discuss implications of the ICS framework for the design and control of temporary systems. Organizations increasingly employ temporary systems to absorb or manage demanding environmental contingencies (Grabowski & Roberts, 2000). Further, these temporary systems often consist of diversely skilled individuals working on complex tasks (frequently across functional, group, or organizational boundaries) to achieve specific objectives in a limited time (Goodman, 1981), frequently in high-risk or high-stake situations (Meyerson, Weick, & Kramer, 1995). These systems may consist of "co-located" individuals or people interacting within a virtual context. Nevertheless, they are often deployed to perform important adaptive functions for organizations by significantly enhancing their ability to manage fluctuations in working conditions. Examples of temporary systems include certain types of alliances, consortia, product development groups, and crisis management teams.

Our framework points to a number of suggestions for developing the organizational capacity to construct, control, and dismantle highly reliable temporary systems. Major and unforeseen competitive threats, supplier collapses, product malfunctions/recalls, technology breakdowns (for instance, "e-commerce" system failure), technological sabotage, hostile takeover attempts, and natural disasters are examples of events for which the ICS approach may represent an especially viable organizational solution. Inept reaction to these sorts of incidents can lead to catastrophic consequences for organizational stakeholders (cf. Lagadec, 1993; Pearson & Clair, 1998). We provide several general recommendations for developing the capability to implement highly reliable temporary systems.

Design structures in advance to manage major potential contingencies. Our research underscores the importance of identifying roles and establishing routines for the general classes of events demanding immediate and appropriate organizational response. Like the emergency situations confronting fire departments, the hypercompetitive or crisis conditions faced by more mainstream organizations may contain a number of foreseeable situational features and task requirements (Pearson & Clair, 1998; Pearson & Mitroff, 1993). In the case of a major product failure and recall, for instance, an organization can expect to be confronted with investigatory, legal, and public relations issues, among others. Our research suggests 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 of organizational dysfunction is diminished.

Devise guidelines to rapidly deploy and alter structures. This study suggests that advance consideration of the following types of questions is vital for developing structuring guidelines or procedures: How should initial system construction commence? When and under what circumstances should certain individuals be responsible for activating and deactivating organizational elements? What are the options for restructuring the system as an incident evolves? When should tasks remain relatively unstructured so that individuals can improvise?

Institute protocols for mental model development and maintenance. The fire department we studied maintains guidelines that function to promote the development and maintenance of useful mental models. Their approach indicates that mental model development processes should address the following kinds of questions: How much attention should be directed to situational comprehension? When and how should individuals initiate mental model development? What communication protocols would insure effective dissemination of information critical to mental models? How can representational responsibility be off-loaded?

Actively discourage freelancing. Our research suggests that serious organizational dysfunction may occur when empowered individuals operating in turbulent environments act without sufficient knowledge of or care for general system objectives and structural arrangements. The presence of cognition management methods promotes useful, as opposed to detrimental or ineffectual, empowered behavior. However, sanctions, such as warnings, reprimands, and terminations, may be required to dissuade individuals from freelancing.

Set up training programs to develop system competence. Given the complexity of an ICS-style coordination system, substantial training and experience with such a system seem to be prerequisites for effective individual performance. The fire department we studied provides its members with numerous ICS training programs, ranging from classroom lectures to simulations.

Assess methods and operations frequently. The organization we studied conducts extensive formal operational assessments after each major incident. More informal evaluations are conducted after minor incidents. Reliability is enhanced to the extent that major problems are identified and appropriate solutions are adopted.

Establish an interorganizational ICS-style program. The ICS was designed to integrate resources not only within, but also across, organizations. Catastrophic events, such as the collapse of a major supplier, government regulatory action, or a product failure, can adversely impact several or many organizations in a particular industry, market, or supply chain. Effective crisis management under these circumstances may necessitate swift, appropriate and coordinated action among organizations. Benefits may accrue to firms able to establish an interorganizational ICS-type framework for disaster management.

A likely scenario through which an interorganizational ICS-style coordination program is likely to emerge is one where a motivated firm possessing leverage over other firms in a network (based on, for instance, market or ownership power) takes the lead in developing the ICS approach and encouraging its adoption. A number of system requirements (the need for common language, standards, training, procedural updates, and so forth) seem to call for a degree of centralized administration for such an organizing scheme. However, our theory does not necessitate such dictation. Certainly, firms in a low-power-differential network could jointly develop an ICS approach and then administer it through a consortium of some sort.

Building and maintaining an effective ICS-type response capability is likely to require a nontrivial commitment of organizational resources. However, when error tolerance is extremely low and, thus, reliability is paramount, highly reliable temporary systems may be superior to alternative organizational forms such as purely organic or mechanistic systems. These temporary systems appear to offer more organizing possibilities and greater response potential than other design options. Investing in a capacity to deploy an ICS-based organization seems imperative for the growing number of organizations facing an expanding number of catastrophic scenarios.

REFERENCES

Adler, P. S., & Borys, B. 1996. Bureaucracy: Coercive versus enabling. ***Administrative Science Quarterly,*** 41: 61–89.

Adler, P. S., Goldoftas, B., & Levine, D. I. 1999. Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. ***Organization Science,*** 10: 43–68.

Asch, S. E. 1952. ***Social psychology.*** Englewood Cliffs, NJ: Prentice-Hall.

Brown, S. L., & Eisenhardt, K. 1997. The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. ***Administrative Science Quarterly,*** 42: 1–34.

Burns, T., & Stalker, G. M. 1961. ***The management of innovation.*** London: Tavistock.

Ciborra, C. U. 1996. The platform organization: Recombining strategies, structures, and surprises. ***Organization Science,*** 7: 103–118.

D'Aveni, R. A. 1994. ***Hypercompetition: Managing the dynamics of strategic maneuvering,*** New York: Free Press.

Endsley, M. R. 1997. The role of situation awareness in naturalistic decision making. In C. Zsambok & G. Klein (Eds.), ***Naturalistic decision making:*** 269–284. Mahwah, NJ: Erlbaum.

Flin, R. 1996. ***Sitting in the hot seat.*** New York: Wiley.

Glaser, B., & Strauss, A. 1967. ***The discovery of grounded theory.*** Chicago: Aldine.

Goodman, R. A. 1981. ***Temporary systems.*** New York: Praeger.

Grabowski, M., & Roberts, K. H. 2000. Risk mitigation in virtual organizations. ***Organization Science,*** 10: 704–721.

Hannan, M. T., & Freeman, J. 1977. The population ecology of organizations. ***American Journal of Sociology,*** 82: 929–964.

Hanssen-Bauer, J., & Snow, C. C. 1996. Responding to hypercompetition: The structure and processes of regional learning network organizations. ***Organization Science,*** 7: 413–427.

Hutchins, E. 1995. ***Cognition in the wild.*** Cambridge, MA: MIT Press.

Ilinitch, A. Y., D'Aveni, R. A., & Lewin, A. Y. 1996. New organizational forms and strategies for managing in hypercompetitive environments. ***Organization Science,*** 7: 211–220.

Lagadec, P. 1993. Preventing chaos in crisis (trans., J. M. Phelps). London: McGraw-Hill.

March, J. G., & Simon, H. A. 1958. ***Organizations.*** New York: Wiley.

McGrath, R. G., MacMillan, I. C., & Venkataraman, S. 1995. Defining and developing competence: A strategic process paradigm. ***Strategic Management Journal,*** 16: 251–275.

Meyerson, D., Weick, K. E., & Kramer, R. 1996. Swift trust in temporary groups. In R. M. Kramer & T. R. Tyler (Eds.), ***Trust in organizations: Frontiers of theory and research:*** 166–195. Thousand Oaks, CA: Sage.

Moorman, C., & Miner, A. S. 1998. Organizational improvisation and organizational memory. ***Academy of Management Review,*** 23: 698–723.

Pearson, C. M., & Clair, J. A. 1998. Reframing crisis management. ***Academy of Management Review,*** 23: 59–76.

Pearson, C. M., & Mitroff, I. I. 1993. From crisis prone to crisis prepared: A framework for crisis management. ***Academy of Management Executive,*** 7(1): 48–59.

Pfeffer, J. 1992. ***Managing with power: Politics and influence in organizations.*** Boston: Harvard Business School Press.

Resnick, L. B., Saljo, R., Pontecorvo, C., & Burge, B. (Eds.). 1997. ***Discourse, tools, and reasoning: Essays on situated cognition.*** New York: Springer.

Roberts, K. H. 1990. Some characteristics of high reliability organizations. ***Organization Science,*** 1: 160–177.

Roberts, K. H., & Rousseau, D. M. 1989. Research in nearly failure free high reliability organizations: Having the bubble. ***IEEE Transactions on Engineering Management,*** 36: 132–139.

Roberts, K. H., Stout, S. K., & Halpern, J. J. 1994. Decision dynamics in two high reliability military organizations. ***Management Science,*** 40: 614–624.

Rochlin, G. I. 1997. ***Trapped in the net: The unanticipated consequences of computerization.*** Princeton, NJ: Princeton University Press.

Roth, E. M. 1997. Analysis of decision making in nuclear power plant emergencies: An investigation of aided decision making. In C. Zsambok & G. Klein (Eds.), ***Naturalistic decision making:*** 175–182. Mahwah, NJ: Erlbaum.

Schilling, M. A. 2000. Toward a general modular systems theory and its application to interfirm product modularity. ***Academy of Management Review,*** 25: 312–334.

Schulman, P. 1993. The analysis of high reliability organizations. In K. H. Roberts (Ed.), ***New challenges to understanding organizations:*** 33–54. New York: Macmillan.

Scott, W. R. 1994. Open peer commentaries on "accidents in high risk systems." ***Technology Studies,*** 1: 23–25.

Simon, H. 1976. ***Administrative behavior*** (3rd ed.). New York: Macmillan.

Simons, R. 1995. Control in the age of empowerment. ***Harvard Business Review,*** 73(2): 80–88.

Strauss, A. 1988. ***Qualitative analysis for the social sciences.*** Cambridge, England: Oxford University Press.

Strauss, A., & Corbin, J. 1990. ***Basics of qualitative research.*** London: Sage.

Taylor, J. R., & Van Every, E. J. 2000. ***The emergent organization: Communication as its site and surface.*** Mahwah, NJ: Erlbaum.

Turner, B. M. 1978. ***Man-made disasters.*** London: Wykeham Press.

Vaughan, D. 1996. ***The Challenger launch decision: Risky technology, culture, and deviance at NASA.*** Chicago: University of Chicago Press.

Wagenaar, W. A., & Groenweg, J. 1987. Accidents at sea: Multiple causes and impossible consequences. ***International Journal of Man-Machine Studies,*** 27: 587–598.

Weber, M. 1947. ***The theory of social and economic organization.*** Glencoe, IL: Free Press.

Weick, K. E. 1990. The vulnerable system: An analysis of the Tenerife air disaster. ***Journal of Management,*** 16: 571–593.

Weick, K. E., & Roberts, K. H. 1993. Collective mind and organizational reliability: The case of flight operations on an aircraft carrier deck. ***Administrative Science Quarterly,*** 38: 357–381.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. 1999. Organizing for high reliability: Processes of collective mindfulness. In B. M. Staw & R. Sutton (Eds.), ***Research in organizational behavior,*** vol. 23: 81–123. Greenwich, CT: JAI Press.

Gregory A. Bigley *(gbigley@u.washington.edu)* is an assistant professor of human resource management and organizational behavior at the University of Washington. He received his Ph.D. from the University of California, Irvine. His research interests focus on trust, motivation, leadership, and the social-psychological foundations of high-reliability and high-performance organizing.

Karlene H. Roberts *(karlene@haas.berkeley.edu)* is a professor of business administration at the Walter A. Haas School of Business, University of California, Berkeley. She received her Ph.D. from the University of California, Berkeley. Her research interests focus on the design and management of organizations in which errors can have catastrophic results.