

---

**ORGANIZATIONAL LEARNING UNDER FIRE:  
THEORY AND PRACTICE**

**Kathleen M. Carley**  
Department of Social and Decision Sciences  
Carnegie Mellon University  
Pittsburgh, PA 15213

**John R. Harrald**  
Department of Engineering Management  
The George Washington University  
Washington D.C. 20052

July 1995

This work was supported in part by a quick response grant 23-92 from the Natural Hazards Research and Applications Information Center.

## **ORGANIZATIONAL LEARNING UNDER FIRE: THEORY AND PRACTICE**

### **ABSTRACT**

As human beings we would like to live in a failure free world. A world where disasters are, ideally, prevented or at least their impact is minimized. Organizations are expected to respond to disasters by minimizing the disaster's impact. Learning is expected to be one of the key mechanism through which organizations come to prevent and minimize the impact of disasters. There are, however, major differences in our theoretical understanding of organizational learning and organizational learning as it occurs in practice. In this paper, we explore the differences between organizational learning in theory and in practice as demonstrated in the actions of the organizations responding to Hurricane Andrew in Miami.

## **ORGANIZATIONAL LEARNING UNDER FIRE: THEORY AND PRACTICE**

Today, many people have the mindset that the world should be failure free. In a truly failure free world, technological disasters simply would not occur and the response to natural disasters would be swift and effective. In particular, high tech organizations that operate in extremely hostile environments, such as the space agency, the modern military, and air traffic control, are expected to operate in this mode (Roberts, 1989, 1990). Nevertheless, failures do occur. Their cause may be either technological (e.g., Exxon Valdez) or natural (e.g., Hurricane Andrew). The basic expectations seems to be that in the ideal world such failures or disasters would be prevented. Organizations should exhibit high reliability and such failures should be rare (Roberts, 1989, 1990). Nevertheless, if a failure occurs, then the impact of such a failure should be minimized. In other words, organizations are expected to respond to disasters, to initiate change, by minimizing the impact.

Why this mindset exists, and whether or not such failures are inevitable (Perrow, 1984) are important questions. However, they are not questions we will attempt to answer. Rather, our interest is in the role that learning plays in minimizing the impact of such "failures"; we will focus on the idea that the way to achieve such "failure free response" is through organizational change. Organizational learning leads to change within the organization, which in turn can lead to change in the way the organization responds to events, which in turn leads to change at the community or global level. Further, organizational learning should admit higher performance (Levitt and March, 1988; Argote, et.al., 1987; Carley, 1992a). The lessons of experience should allow the organization to respond to future events in a more efficacious fashion, thus minimizing the impact of failures (Carley, 1991). By changing, by adapting, organizations should be able to respond better to future disasters. That is, organizational response should be more timely and should minimize the impact of the disaster at all levels.

Organizational learning should, at least in theory, play a major role in disaster response. Organizational learning has been characterized in a variety of ways. Organizational learning, for example, has been

characterized as the development of routines, standard operating procedures, and accounting procedures (Cyert and March, 1963; March and Olsen, 1975; March, 1981; Nelson and Winter, 1982; Johnson and Kaplan, 1987; Levitt and March, 1988), cumulative production skills (Preston and Keachie, 1964; Rosenberg, 1982; Dutton and Thomas, 1984; Argote, et.al., 1987), the development of consensus (Bavelas, 1950; Cohen, 1962; Cohen, et al., 1969; DeGroot, 1974; Hastie, 1986), determination of the optimal decision rule (Marschak, 1955; DeGroot, 1970; McGuire and Radner, 1986; Grofman and Owen, 1986), emergence of effective communication structures (Leavitt, 1951; Shaw, 1954; Shaw and Rothschild, 1956; Guetzkow and Dill, 1957; Cohen, 1962), and improved accuracy in problem solving (Carley, 1992a; Lin and Carley, 1992). When actual organizations have been examined the case is not always clear as to whether organizational learning has occurred, whether such learning actually improved performance, and whether such internal change resulted in changing the way the organization responded to its environment. Particularly with respect to training and experience, data suggest that losing personnel may either degrade or improve organizational performance (Price, 1977; Argote, et.al., 1987; Tushman, Virany and Romanelli, 1989). Change in CEOs may or may not initiate change in the way the organization responds to its environment. This suggests that there are major differences in our understanding of organizational learning at the theoretical level and the occurrence of organizational learning in practice. This suggests that there may be a gap in our theoretical understanding of how change is initiated in organizations and the actual barriers to and forces for such change in practice. We will contrast what theories of organizational learning imply should have happened in the disaster situation in Miami with what we observed happening.

Early Monday morning, August 24, 1992 Hurricane Andrew crossed South Florida. Most communities in its path were damaged by wind and flying debris. An estimated 85,000 homes were damaged or destroyed, and over a quarter of a million people were rendered temporarily homeless. A federal disaster was declared almost immediately, but county, state, and local organizations had to face the initial, overwhelming response needs with existing resources. Hurricane Andrew was the first test for the Federal Emergency Management Agency's (FEMA) Federal Response Plan. This plan embodied a set of organizational agreements for how to respond to this type

of disaster. Presumably such a plan reflected the knowledge that had been learned in previous disasters. Within a week, it was apparent that the plan had failed to provide an effective and integrated federal response. FEMA opened its disaster field office in Dade County on Thursday, August 27. On Friday, August 28th, President Bush directed Secretary of Transportation Andrew Card to oversee the federal response and mobilized a military support operation that grew to over 30,000 men and women.

The rapid declaration of Miami as a national disaster led to an expectation on the part of the victims that they should be helped immediately. Or, as one of the Red Cross managers commented, "When a place is declared a disaster five minutes after the event, people expect response ten minutes after the event." This expectation of rapid response put incredible stress on all responding organizations and increased attention to organizational response. This increased response made it highly necessary for organizations to employ the lessons of previous experience, their learning, and it became highly obvious when they did not employ such lessons.

By concentrating on this highly stressed environment, the differences between theory and practice, with respect to organizational learning, come into sharp relief. To provide the groundwork for this analysis we will first consider two factors: (1) the interrelationship between disasters and organizational learning, and (2) what was and was not learned from recent major disasters (Hurricane Hugo and the Loma Prieta earthquake). We will then examine a series of theoretical propositions concerning organizational learning. We will conclude by commenting on the actual role of learning in disaster settings.

## **DISASTERS AND ORGANIZATIONAL LEARNING**

Schein (1972) suggests that unfreezing events are necessary for significant organizational change. Major disasters are such unfreezing events for organizations. The basic idea is that organization get into ruts. They learn a pattern of response or a set of procedures that then largely dictate their actions. When a disaster occurs, this pattern and these procedures are called into question. The unfreezing caused by the disaster allows the organizations to get out of the rut, alter their pattern of response, and develop new procedures. However, the thaw produced by the disaster is of limited duration. In other words, disasters create a window of opportunity during

which changes can occur. After this window closes, change is less likely. Thus, organizations responding to disasters learn in leaps — disaster by disaster — rather than smoothly over time.

Since disasters, particularly catastrophic disasters like Hurricane Andrew, are low probability events there exists a public perception that such events cannot happen. After such events occur, individuals' perceptions shift and they view such events as possible or even probable. This creates an increased interest in mitigating such events. It also causes other unlikely events to become less salient. Consequently, after an earthquake planners focus almost exclusively on future earthquakes, after a hurricane planners focus almost exclusively on future hurricanes. For example, prior to the Exxon Valdez little attention was given to responding to the low probability event of a major oil spill. In fact, response readiness actually degraded over years of disaster free operation (Harrald, Marcus and Wallace, 1990). After the Valdez, attention was focused on responding to catastrophic oil spills. The upshot was new legislation and plans for dealing with such contingencies. Little attention, however, has been given to other potential maritime crises such as fires or chemical releases. Thus, organizations responding to disasters learn in categories, one disaster type at a time.

#### **HURRICANE ANDREW: WHAT WAS AND WAS NOT LEARNED**

An NSF supported Rapid Assessment study was conducted by Carley and Harrald that compared the evolution of the Hurricane Andrew Response organization to that contained in FEMA and Red Cross plans. The researchers observed the organizations that provided sheltering, food, and supplies to disaster victims in Miami. The operations of the Federal Disaster Field Office, the Red Cross Disaster Relief Operation HQ, and various service delivery operations were observed during a week on scene. Response personnel were interviewed at the site, and subsequently. For an overview see Carley, 1992b.

During this time it was clear that both organizations were employing, in some cases, the lessons of experience, while in others they were acting as though they had failed to learn from previous situations. In describing what the organizations learned and did not learn we are not making a judgment as to whether these organizations responded well or inappropriately to the situation. It is not our purpose to critique the response behavior of either the

Red Cross or FEMA. Rather, our interest is in illustrating the types of actions taken by these organizations that represented learning, that represented changes from actions in previous disasters. As a further caveat, this is not an exhaustive list of what was and was not learned. Rather, it is representative of the kinds of learning that did and did not occur.

The disasters that occurred during the fall of 1989 were significant learning events for FEMA and the Red Cross. Hurricane Hugo devastated the American Virgin Islands and Puerto Rico on September 19, 1989. Several days later it came ashore at Charleston S.C. with devastating force. On October 17, 1989, the Loma Prieta earthquake occurred in California. FEMA and the Red Cross were faced with conducting simultaneous major disaster relief operations in three, geographically separate locations. Both organizations experienced significant problems and received public and media criticism as a result of these operations. After the operations were concluded, both organizations conducted extensive internal examinations of their preparedness for and execution of their disaster relief responsibilities (see for example National Academy of Public Administration 1993; American Red Cross 1991a). The Red Cross completed 13 separate studies and evaluations. FEMA conducted an extensive evaluation that has never been released to the public. The General Accounting office also evaluated FEMA's readiness and response (General Accounting Office, 1993). As a result of these studies, the Red Cross re-organized and expanded their disaster services, initiated a catastrophic disaster planning effort, and expanded their base of trained volunteers. FEMA initiated a major planning and coordination effort that resulted in the creation of the Federal Response Plan and the signing of the implementing Memoranda of Understanding with other Federal Agencies and with the American Red Cross. The stage was set for the next major disaster to see what had been learned and what had not been learned.

## RED CROSS

The Red Cross had clearly learned how to do staffing and mobilization. They had learned where and how to set up staging areas and how to access personnel so that a personnel response structure could be rapidly put into place. The Red Cross improvement in their ability to mobilize and organize trained and qualified relief workers was remarkable. The ARC had brought

over 550 people into Dade County by Thursday morning (72 hours after Andrew's landfall) to supplement their 1,500 local volunteers and staff. Their Dade County operational headquarters was fully operational 48 hours after the disaster. (FEMA at this point was still operating out of Tallahassee.) The mobilization effort required to staff the Florida operation, Hurricane Andrew Louisiana, and Hurricane Iniki in Hawaii was smoothly coordinated at ARC headquarters. In contrast, staffing and mobilization were major problems for the ARC during the response to Hurricane Hugo. Computer systems were inadequate to support the mobilization and critical shortages of trained staff hampered the operation (Harrald, et al., 1990).

The Red Cross had also learned that a senior management presence at the scene was required. During the Andrew response, Donald Jones, the General Manager of Red Cross Disaster Services maintained a presence on scene for several weeks during the initial response. There was a need for a high level organizational presence to coordinate with peers in other organizations (e.g., Cabinet officers, three star generals, and the mayor). Don Jones provided this high level presence, Chris Saeger, the disaster relief operation director, could not. There was also a need to have a senior person available for media and external relations. The absence of this type of presence had contributed to a critical reception by the press and a perceived lack of coordination with other agencies during the Loma Prieta and Hurricane Hugo operations. Don Jones also played this external relations/media role. Chris Saeger could have played this role, however, it would have taken him away from his primary role as job director.

The Red Cross has an institutional memory for what some other volunteer groups can and generally will do what. This learning is embodied in the experiences of Red Cross personnel who remember from previous disasters and have been trained regarding which volunteer organizations to count on for what. Examples of such learning include commonly expressed views that: "the Salvation Army provides clothes," "the Mennonites do rebuilding," and "the Southern Baptists cook food." Some of this learning has been institutionalized in written procedures and some is retained in individual memories.

The Red Cross has learned to be sensitive to certain minorities. After Hurricane Hugo the Red Cross was criticized by local political leaders and the media for not actively seeking affected areas containing poor minority

residents. As a result, the ARC was perceived to be slow in responding to the needs of these minorities. This learning is seen in the increased attention and focus of Red Cross personnel during the response to Hurricane Andrew on minority, and particularly, African-American issues. This learning, however, represents case learning and a distinction between formal learning (policy) and applied learning (practice). The policy (formal learning) was to determine and respond to the needs of all minorities. The organizational reality (applied learning) was that the only formal linkage that worked immediately to react to the needs of a minority was the linkage to the African-American churches (AME) which enabled ARC to respond to the needs of the African-American community. Other linkages to other minorities formed later.

The Red Cross had learned that estimating the need for Red Cross services was a critical task (Harrald et al, 1991). They had developed service demand estimating algorithms based on severity of damage and the demographics of the affected population. They purchased a commercial CD-ROM demographic data base to assist in this effort. They did not, however, make provisions to improve their ability to obtain a rapid initial assessment of damages. As a result, the estimates produced at Red Cross headquarters within 23 hours of the disaster were remarkably accurate and were used to guide staffing decisions. The ARC did not have concrete damage assessment data on which to base these estimates, however, and they were not released to other agencies. The information that could have assisted in the allocation of resources and siting of centers was not available, and these decisions were handicapped until a detailed damage assessment was available.

The Red Cross had not learned the effective use of information and information management. For example, in Loma Prieta and Hurricane Hugo information was not regularly reported up the chain to headquarters. This led to a lack of awareness on the part of headquarters as to what was being done locally and decreased the ability of headquarters to coordinate at higher levels. This same failure of communication and, ultimately of coordination, happened in Andrew. As a second example, in Andrew, as in all previous disaster response efforts the Red Cross did not have the ability to rapidly process dispersing orders (documents issued to victims and used to purchase goods from local merchants). Information needed was kept on paper, in highly redundant fashion. The information was not organized to admit rapid

access at multiple sites. There were missing information flows; e.g., there was no mechanism for rapidly feeding detailed damage assessments into family service centers. New technology did not lead to changes in the way in which information was processed. As a third example, the Red Cross had not established procedures and systems for rapidly providing disaster family inquiry (DWI) information. The role of ascertaining the whereabouts and conditions of victims for concerned relatives has been a traditional one for the Red Cross and was formally assigned to them by the Federal Response Plan. In Miami, the Red Cross DWI operation was slow and marginal. The need was met by other ad hoc methods. For example, local newspapers provided free space for locator information, telephone companies provided free voice mail and temporary phone service.

#### FEDERAL EMERGENCY MANAGEMENT AGENCY

The major lesson learned by FEMA from Hurricane Hugo and Loma Prieta was that it needed better inter-organizational planning and preparedness. Consequently, prior to Andrew there was a plan. The effort to develop a Federal Earthquake Plan was expanded and accelerated to produce the first comprehensive Federal Response Plan. Although, the plan was published in April 1992, it was not widely distributed until after Hurricane Andrew. The Federal Plan did provide both an organizational concept of operations and, through the signatures of the 27 agency heads, the acceptance of the designated roles and responsibilities. The creation of the plan did not, however, ensure effective inter-agency coordination, the ability of individual agencies to execute their responsibilities under the plan, or the efficacy of the concept of operations. Readiness exercises conducted by FEMA indicated that problems could occur in these areas (response 91A) but the full scope of the shortcomings did not appear until Hurricane Andrew.

FEMA had learned from Hurricane Hugo and their response exercises that they needed better interagency coordination. In Andrew, the awareness that interagency coordination was seen as a priority was evidenced by the provision of space for all agencies in the Disaster Field Office, and the rapid assignment of a senior FEMA manager as the Federal Coordinating Officer (Phil May, the Director of FEMA Region IV). Most agencies participating in the federal response had personnel assigned who were designated as liaison officers. However this coordination structure became secondary once the

FEMA run Disaster Field Office was supplanted by the Presidential Task Force directed by Secretary Card. Inter-organizational coordination was accomplished through two a day staff meetings held by Secretary Card. It is relevant to note that these staff meetings provided greater access to local governments than did the pre-planned mechanisms specified by the Federal Plan. The plan assumed that the primary coordination needs would be intra-federal and federal-state.

FEMA had also learned that better coordination and interaction with volunteer organizations was required. Since most volunteer organizations provide direct services to victims, FEMA's solution to this need was to designate the Red Cross as the lead agency for ESF 6 (Mass Care). Volunteer agencies involved in other aspects of emergency response (e.g. communications) are ignored by the Federal Plan. During Hurricane Andrew however, there was confusion over the extent to which FEMA had authorized the full activation of ESF 6 and the Red Cross fell back on their more traditional methods of volunteer agency coordination (e.g. through their lead in the Volunteer Agencies Active in Disasters (VOLAD)). The failure to immediately fully staff and activate ESF 6 and the assumption of federal leadership by Secretary Card effectively removed the mechanisms for voluntary agency coordination established in the Federal Plan.

In spite of severe criticism after Hurricane Hugo, FEMA had not learned that they would require a rapid initial assessment of disaster damage and would be expected to respond quickly to the needs of victims. The FEMA situation reports on disaster damage submitted by the Disaster Field Office (DFO) to Washington four days after the hurricane struck were wrong by an order of magnitude. They contained estimates of 6,000 homes affected when the actual number was between 75,000 and 85,000 and estimates of 400,000 dwellings without power when the actual number was in excess of 2 million. The initial FEMA response went according to plan; the federal presence and the federal capability for supporting state request for assistance were established. When the media and the local government agencies demanded more, FEMA's plan and organization was supplanted by the Presidential task force and the military presence directed by President Bush.

In our opinion, this sequence of events was due in part to the failure of FEMA to learn two related critical lessons: the importance of managing information effectively and the importance of using this information to

establish realistic public perceptions and expectations. Although the federal plan provides for the establishment of a central information and planning function (ESF 5), this capability was not established in Dade county until four days after the disaster. By this time the media, the public, the President, and most agencies were obtaining their information elsewhere.

Since FEMA viewed its initial responsibility as establishing the federal structure and had not rapidly established a viable information presence, it was not able to ensure that the federal response adjusted to the demographics and culture of the region. FEMA had not learned from hurricane Hugo, as the Red Cross did, that demographic information that allows responders to identify income and ethnic distributions is essential to the initial response.

#### COMMENT

As previously noted, this brief description of what the Red Cross and FEMA had and had not learned should not be taken as a complete list. Rather, these items are indicative of the learning that has and has not occurred. Several interesting aspects of organizational learning come to light even within this brief description. The first point, is that there is organizational learning. For both the Red Cross and FEMA response to Andrew was fundamentally affected by the lessons of Hurricane Hugo and Loma Prieta. This learning may not be complete, it may not generalize (as in the case of the minorities), it may not be sufficient to satisfy the victims, but it does occur. The second point, is the fact that organizations who respond to the same disaster may come away learning very different things. The Red Cross learned from Loma Prieta and Hurricane Hugo that they need to respond to minorities, FEMA did not. Third, there is a major difference between learning the need to do something and learning how to do something. Where it may only take a single disaster to cause organizations to learn the need for something, it may take many disasters before they learn how to fill that need.

This brief discussion of the learning underlying response to Hurricane Andrew provides a groundwork from which we can build. In the following section we build on this groundwork by discussing in more detail particular theoretical expectations about organizational learning. We contrast expectations with practice given the actions of the Red Cross and FEMA.

## LEARNING: THEORY AND PRACTICE

### LEARNING THROUGH PLANNING

In theory, planning leads to improved performance (Michael, 1986; Weingart, 1989). Consequently, in many areas, attention is paid to developing automated planners (Corkill, 1979; Thorndyke, 1981). Planning is expected to improve performance for a variety of reasons. First, the act of planning is expected to ensure knowledge of the plan. Second, the act of planning is expected to provide practice or training which will admit higher performance during the actual situation. Third, the act of planning is expected to ensure that the plan is followed as the planners will feel ownership of the plan and so committed to carrying it out. Fourth, having a plan defines roles and so allows more rapid response because these roles do not have to be negotiated. Fifth, plans define communication and resource channels, who knows what and who has what. This should admit higher performance due to a decrease in the need to locate information and resources.

In practice, however, plans are laid aside. In Miami, despite the existence of a plan — the federal plan — the plan was not followed. The act of planning did not improve performance. This is largely because the planners were not the practitioners. The practitioners had no ownership of the plan and often had not read it. At FEMA headquarters a few photocopies of the plan were lying around on shelves, but were rarely consulted, and few response personnel at either FEMA or the Red Cross had read the federal plan. Many personnel at FEMA and Red Cross exhibited little understanding of the plan. Time was spent discussing whether or not the plan had been activated and, if it had, what their role was. Because the planners were not the practitioners the benefits of the planning process — knowledge, practice, and commitment — did not occur. The federal plan served more as a treaty setting limits on the intervention that one response group could take vis. another group than as a document of responsibility. Roles, communication channels, and resource channels were not well defined. FEMA and Red Cross personnel spent time negotiating and defining their roles, establishing communication channels, and trying to locate resources.

There are several reasons that this negotiation occurred. Confusion over whether the plan was implemented and what it stated led to the need to

clarify roles. In addition, by August 27th, three days after Andrew had touched down, it appeared that the plan was not working. The appointment of Secretary Card by President Bush to head up a disaster response task force on August 28th was an act outside of the federal plan, creating further discussion of the viability of the plan. Because the plan was called into question so early in the response process FEMA and Red Cross personnel spent time negotiating their roles. This negotiation had significance for the current as well as future disaster operations. Finally, the plan itself was not a document of responsibility simply because in creating the plan no effort was made to determine whether in fact the organizations who were assigned particular roles had the resources necessary to fill those roles. In many cases, organizations did not have the necessary resources for the tasks assigned them. For example, the Red Cross was assigned the role of coordinating mass care; but, clearly the Red Cross does not have the resources, by itself, for helping a quarter of a million homeless people. There is a need for other volunteer and government agencies to work together to meet these mass care needs. The Federal Response Plan envisions that the Red Cross will coordinate the actions and resources of other agencies. However, the Red Cross does not have the clear authority to coordinate other volunteer agencies in this endeavor and the acceptance of its leadership by other agencies was still evolving when Andrew struck.

#### LEARNING AND CATASTROPHIC EVENTS

The role of learning relative to catastrophic events is not well understood. Within the literature a variety of theoretical viewpoints are forwarded. Let us consider two of these: one-of-a-kind-decisions, and scalability. According to the one-of-a-kind-decision perspective, catastrophic events are one of a kind events. They are events that cannot be planned for. Moreover, they are such a unique situation that learning cannot be transferred. If such is the case then all that can be done is to minimize their likelihood. According to the scalability perspective, catastrophic events are just like smaller events only larger. It follows from this perspective that the main issues are location and distribution of resources, and communication. New procedures do not need to be developed and no new factors come into play. If such a perspective is correct then coping with catastrophic events simply require developing better information technologies.

In practice, the theory that catastrophic events cannot be planned for has been affirmed by organizational actions. That is, organizations have argued that it does not make sense to plan for the highly unlikely event as that ties up resources unnecessarily. Exxon was seen to argue this point in their advising the local Alaskan government to not develop their own oil cleanup equipment. Such actions, however, come into sharp contrast with the social view of "we must be taken care of" and "organizations should operate failure free." Thus leading organizations, and inter-organizational groups to engage in planning activities for events that they expect never to happen and so do not provide resources. Arguments of scalability can be used by planners to define organizational roles. Even if the scalability theory is correct, negotiation of roles based on scalability without providing resources leads to built in modes of failure in the plan. The development of the federal response plan can, as we saw earlier, be viewed in this way. Ultimately, the theory of the one-of-a-kind event and the theory of scalability are at odds, and response planning predicated on both theories is doomed.

The doom of such plans is particularly likely given that there is simply no evidence that scalability applies. A hurricane is not simply a big tornado. Issues involved in repairing or rebuilding 85,000 homes and providing care for over a quarter of a million homeless people are far different than those involved in repairing a few dozen homes. For one thing, issues of civil defense and long term ecological changes arise. For another, when entire communities are destroyed it is not enough to simply provide immediate food, clothing, and shelter. Rather, the entire infrastructure has to be rebuilt, new businesses developed, new communication services provided, and relocation programs started. Under such catastrophic conditions the demarcation between immediate response, short term response, and long term response become blurred and the responsibility of organizations for each such phase is called into question.

### LEARNING FROM FEEDBACK

In theory, learning requires feedback. With feedback, organizations can learn to increase the accuracy of their response and improve their performance (Lindblom, 1959; Steinbruner, 1974; Levitt and March, 1988; Carley, 1992a). In all learning theories, feedback that enables performance improvements is of a form that allows a determination of "how close are we to

the goal?" The more accurate the feedback, the more rapid the feedback, the better the organizational performance. The ability of the organization to learn from feedback is reduced when the feedback is not objective, when organizational personnel are unwilling to accept feedback, when institutional concerns prevent acceptance of feedback.

Disaster response organizations, in many ways, represent almost a classic example of organizations which have a strong tendency to fail to learn from feedback. Internal feedback is not provided. For example, within the Red Cross measures of effectiveness are of the form "x meals served" and "y persons sheltered". Essentially what they are doing is using activity measures as surrogate measure of output or outcomes (Harrald, Marcus and Wallace, 1990). Such information, however, does not enable learning as it does not say what needed to be done, only what was done. External feedback is particularly difficult to provide to disaster response organizations. FEMA and the Red Cross do utilize outside consultants to provide objective feedback.

During the initial response to the disaster response organizations do not want criticism. Personnel are often in a highly charged emotional state suffering from stress and sleep deprivation. In this situation it is difficult to provide on-the-spot feedback in a way that it will be accepted. Feedback, even when not meant as such, is often taken as negative criticism. Since many of the personnel are volunteers, anything that appears as negative criticism may lead to a reduction of the workforce. Feedback, after the initial response period is over, is also not appreciated. Response organizations like FEMA and the Red Cross are subject to governmental review. As a result, feedback is often viewed as criticism and so as a potential threat to organizational survival.

In addition to these classic reasons for not learning from feedback is another culturally based reason. That is, organizations are unlikely to learn from feedback if that feedback is inconsistent with the local organizational culture. It became very clear in 1977, for example, that after the ARGO MERCHANT oil spill the US Coast Guard was being pushed and supported by Congress and public interest groups to become a more capable oil pollution response force. Senior managers in the Coast Guard however, realized that this course of action would require the allocation of capital funds to resources that could only be used for oil spill clean up (skimmers and booms) and would

require the creation of specialized, non sea going, civilian positions (clean up experts, lawyers, accountant). This ran counter to the Coast Guard's perception of itself as a multi-mission, seagoing, military organization. The then Vice Commandant of the Coast Guard stated to the author that he perceived that investing in lawyers, accountants and stuff on the beach was against the long term interests of the Coast Guard, even though the public support to do so was strong. In contrast, the Coast guard aggressively pursued the "drug war" of the 1980's, and gained a significant expansion in its base of multi mission ships, boats, and aircraft. After the EXXON Valdez incident and the resulting Oil Pollution Act of 1990, the Coast Guard is investing in the mission specific resources and staffs rejected in the 1970's.

FEMA has frequently been given the feedback that they need to become a quick response force. However, this rapid response is neither in their charter nor in their culture. In contrast, the Red Cross has been given the feedback that they should make more effective use of volunteers and should take advantage of locally available skilled labor (which could be either volunteer or paid temporary help). The use of volunteers is part of the corporate culture, a culture which is in many ways epitomized by their motto. The ARC corporate mission statement is (in part): "The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters..." The Red Cross organizational objective and culture of relying on volunteers may inhibit effectiveness when a situation is best handled by a non all volunteer work force. Even if the policy were one of effective use the reality is that some volunteers are not used effectively. For example, volunteers are used to work in warehouses operating heavy equipment for which they have not been trained. In part, volunteer organizations cannot be overly choosy and often must make do or satisfice.

Clearly disaster response organizations, like FEMA and the Red Cross, can learn through feedback. They tend not to, unless forced to by a catastrophic disaster. For the U.S. Coast Guard, the Exxon Valdez was an incident of this caliber. After the Valdez the Coast Guard did indeed take on the resources needed to act as a pollution control force. For FEMA and the Red Cross, Hurricane Andrew was such a catastrophic event. What response to feedback will occur, however, has yet to be determined. Think of perfect, failure free, performance as the target toward which response organizations

such as the Red Cross and FEMA are headed. Their tendency not to learn from feedback means that their ability to move toward this target is limited.

### MEDIA EVALUATION AND LEARNING

The type of task facing the organization defines its performance. That is, the task being done sets standards against which the organization's performance can be judged. Organizational learning leads to improved, but not perfect, performance (Perrow, 1984; Carley, 1992a). Performance limits are, in theory, defined by the task and the organization's design (MacKenzie, 1978; Carley, 1992a; Lin and Carley, 1992), and the technology (Perrow, 1984; Thompson, 1967).

In contrast, in Miami the media defined performance. Performance was not judged relative to what was possible, to what was done in the past, but by what the media suggested should be done. The press, however, was highly volatile thus causing performance criteria to change rapidly. In other words, the press caused the target to change; e.g., from failure free response to rapid response. Response organizations, such as the Red Cross and FEMA, even if they had a tendency to learn from feedback, would have found learning difficult in this situation as the target toward which they were learning was constantly changing.

### LEARNING SCENARIO AND PERFORMANCE

In theory, following standard operating procedures or doctrine reduces the impact of personnel turnover (Lin and Carley, 1992). Consequently, organizations who train personnel to follow standard operating procedures rather than to make decisions on the basis of their own experience can employ less experienced personnel. In addition, the necessary training should take less time. Decreased training costs and decreased need to hire experienced personnel may decrease the organization's operating costs. Further, the use of standard operating procedures need not degrade performance relative to that in an organization where personnel follow their own experience (Carley, 1988). However, following standard operating procedures should lead to rigidity. As suggested by Weber (Weber, 1968) and Downs (Downs, 1967), the use of standard operating procedures lead to the development of a bureaucracy where exceptions become impossibilities.

In Miami we saw support for these theoretical arguments. The Red Cross relies on volunteers, many of whom have little or no experience. With remarkably little training new volunteers were able to operate with reasonable effectiveness because they were following standard operating procedures. Damage assessment in particular operated largely in this fashion. Clearly the use of such volunteers keeps down the cost of operations and allows the Red Cross to operate on the basis of donations. A similar story can be told for FEMA. In both cases, the use of procedures led to organizational rigidity and the development of internal bureaucracies. For example the Red Cross family service function (financial assistance to individual families) is highly structured and procedure driven and allows for few exceptions. In FEMA the disaster service center acts in a bureaucratic fashion with certain guidelines as to when loans can be given. In Miami, despite the need for these guidelines to be adjusted, FEMA would not adjust them, until they received a presidential order that removed constraints.

In addition, in Miami we also observed that the impact of following standard operating procedures goes beyond these theoretical predictions. We will make two such observations. First, there is an interaction between experience and following procedure which leads to a rigidity of the middle. Within the Red Cross, for example, new personnel with no experience receive a limited amount of training (a few hours) and then are thrust into service. Such personnel tend to follow standard procedures unless they encounter a situation for which the procedures do not apply. In this case, new personnel fall back on their personal experience. This can lead to highly creative solutions to problems at the lowest organizational level. Mid-level in the organization, personnel have more training in standard operating procedures and a limited amount of experience. At this level, personnel tend to follow procedure almost dogmatically. Rigidity of response is highest at this level. An example of this occurred at a meeting of voluntary agencies, attended by the authors, where a Red Cross worker was told by the gathered church ministers that Homestead was devastated and there was nothing left standing. The Red Cross worker responded saying that they wanted to put a service center in this area and that they needed a building of a certain predefined size. The ministers, in frustration, responded — "THERE'S NOTHING THERE!". In point of fact, there were buildings in Homestead and they were ultimately used. Overall, the finding and assigning of centers

went fairly smoothly. Our point, however, was that at this meeting the Red Cross worker acted in a rigid fashion. A better example of the rigid middle occurred with respect to the mass care function — the use of Emergency Response Vehicles (ERVs). Mass care personnel were not inflexible; however, increased flexibility could have enhanced operations. Mass care personnel had an understanding of how ERVs should be used based on their experience: to distribute food to service centers and to haul stuff from the warehouses to the shelters, kitchens, and service centers. The ERV is outfitted to serve food and can only carry relatively small amounts of supplies. The mass care personnel did not entertain alternatives that could have enhanced their operational flexibility such as renting commercial trucks to carry supplies and saving the ERVs for direct food distribution to victims. They didn't recognize the role of the well marked ERV as a source of information. (While riding in an ERV one of the authors was besieged with questions everywhere the ERV stopped. Many of these questions could have been answered had the ERV carried lists of ARC, FEMA and state centers and addresses.) The drivers of the ERVs were focused on performing their traditional roles and did not quickly or easily adapt to innovative tactics that could have been very effective (e.g., driving through neighborhoods looking for groups of victims in need of ARC service, proactively distributing information). At this level, the entire operation was procedure driven not process driven.

Finally, at higher levels within the Red Cross, personnel have extensive experience with disasters. Such personnel tend not to follow procedures but to develop new procedures and attempt to dynamically refine old procedures to the new situation. This can meet with resistance from mid-level personnel who are rigidly following pre-defined procedures. Our second observation is that standard operating procedures serve as emotional barriers. Personnel within the Red Cross and FEMA, particularly those dealing directly with victims, are placed in a situation where the high emotional trauma, lack of sleep, and stress of the situation can lead them to over-identify with the victims. Such over-identification can lead to a feeling of personal responsibility, higher turnover, and inequity in response to victims. Standard operating procedures serve as a buffer, allowing the personnel in the response organization to place responsibility for their actions on the organization — "I was just following orders." This may be reducing stress, decreasing turnover, and facilitating more equitable response to victims.

## ORGANIZATIONAL DESIGN AND LEARNING

In the short run, teams where personnel are empowered to act on the basis of their experience tend to outperform teams where personnel follow standard operating procedures (Lin and Carley, 1992). When organizational personnel are empowered to act on the basis of their experience, the natural ability of humans to learn, to adapt, enables the organization to learn. Both theoretical models and human experiments have demonstrated that when organizations are composed of personnel who adapt relative to their experience, teams tend to learn faster and so come to outperform more centralized or hierarchical organizations, at least in the short run (Carley, 1992a; Carley, 1990). Further, theoretical models have also demonstrated that in the long run hierarchical organizations are more resilient, and so able to outperform teams (Carley, 1992a). Within hierarchies learning becomes embedded not only in personnel but in the relationships among personnel, whereas in teams learning is only embedded within personnel. Thus turnover and poor performance have less effect on the hierarchy than the team.

In Miami we found support for these arguments. Teams formed on the fly that effectively dealt with most crises. A team that was markedly effective was the coalition between the Red Cross minority liaison, the Southern Baptists' liaison, and the Church World Service's liaison who worked together to ensure that overlooked minority groups in the hardest hit areas were served. At least in one case, where hierarchies were established, at the immediate response level, organizational performance was adversely impacted. An example of this is family services. In Miami, as time progressed, both the Red Cross and FEMA put hierarchies into place. These hierarchies enabled the organizations to establish internal normalcy, to make use of volunteers, and to rotate personnel. By 18 days after Hurricane Andrew hit Miami, the Red Cross and FEMA had their hierarchies so established that they were able to begin rotating personnel with no degradation in performance. From the theoreticians viewpoint the good news is that the theories work. From a policy standpoint this suggests that response organizations such as FEMA and the Red Cross should establish triage teams immediately following the disaster to respond directly to the victims. Research efforts should focus on determining the appropriate personnel to bring together in such teams. Relying on effective teams to form

on the fly, as they did in the example above, may not be a sufficient organizational response.

### LEARNING AND PROMOTION

In theory, learning occurs incrementally. The more experiences the individual has, the more experience, the better their performance and consequently, the better the organization's performance (Carley, 1992a).<sup>1</sup> Promotions based on experience, on skills, are expected to improve organizational performance (Weber, 1968).

In practice, of course, there is a difference between seniority and experience when one is concerned with rare events. This is due, in large part, to the fact that catastrophic events are not simply scaled up small events. Within both the Red Cross and FEMA experience and seniority play a role in promotion and job assignment. However, the experience that people have may not be the appropriate type of experience. The rarity of the catastrophic event is such that most personnel rise to positions of authority on the basis of experience in noncatastrophic situations. For example, in the U.S. Coast Guard when the Exxon Valdez occurred people at senior levels had never experienced anything like a situation of that magnitude. Personnel who had experienced such a situations were no longer in the Coast Guard. Based purely on the experience of its personnel, had the Exxon Valdez occurred five years earlier the Coast Guard would have been better off. In Miami, the Red Cross was at a similar disadvantage. Very senior personnel who had experience with catastrophic events such as Hurricane Hugo and Loma Prieta did not participate in the Red Cross response to Andrew as they were no longer part of the Red Cross or were assigned to positions that precluded their participation in this response effort. Because problems in the disaster response area are not scalable, experience tends to dissipate as the demography of the organization changes. Consequently, these organizations need to develop ways of transferring information other than through experience. Possibilities include the use of simulated events and restructuring the response organizations so that high level personnel are less likely to retire early or leave the organization. Another possibility is the

---

<sup>1</sup> However, experience, when it leads to decrease in creativity can actually be dysfunctional for the organization (Price and Mueller, 1981).

development of standard operating procedures and information systems which embody the lessons of experience (Levitt and March, 1988). However, as we have already discussed, the employment of standard operating procedures can lead to organizational rigidity, particular in the middle of the organization, thus reducing the effectiveness of organizational response to novel situations.

## DISCUSSION

As we have seen, organizational learning in theory and in practice are somewhat different. We have seen that planning is not a panacea and that plans tend to be laid aside. That conflicting views over the nature of catastrophic events, and what can be learned, lead to the development of plans that are not viable. We have seen that feedback is necessary for learning but that it is often not available to, or wanted by, disaster response organizations. We found that where objective performance feedback enables organizational learning, disaster response organizations are more likely to receive subjective performance feedback from the media which decreases their ability to learn. We found support for theories of the relationship between organizational design and learning for cases where the organization relies on its personnel's experience. However, we also found that to minimize costs and the impact of turnover, disaster response organizations tend to employ standard operating procedures (as is suggested by theoreticians). However, there is an interaction between the response based on experience and that based on standard operating procedures due to the seniority system which leads to a rigidity in the middle of disaster response organizations. And finally, we found that even given the desire to empower decision makers to act on the basis of experience, disaster response organizations suffer from a dissipation of experience due to the fact that catastrophic events are not scalable.

Our analysis suggests that organizational learning occurs in stages. In Figure 1 we present a taxonomy of organizational learning as it occurs in response to rare events. This model is based on the premise that learning involves three steps: (1) problem recognition (due to a failure during an actual or simulated event), (2) problem solving, and (3) implementation of solutions. There are eight potential outcomes given this taxonomy. See Table 1. Organizational learning may not succeed due to: failure to identify

the problem (case 1 and 2), failure to attempt to learn (case 3, 4, and 5). failure at problem solving (case 6), failure to effect change (case 7). Clearly, there are many ways by which an organization can fail in the learning process. To initiate successful change the organization needs problem identification knowledge, knowledge about how to learn, knowledge about how to solve problems, and knowledge about how to effect change. Unfortunately, even with such knowledge change may not be initiated due to failure to act.

**\*\*\* Place Figure 1 About Here \*\*\***

**\*\*\* Place Table 1 About Here \*\*\***

Organizations that fail to identify the problem have failures in their "scouting" function. Such organizations fail to determine what are the potential critical problems and when and how they will occur. The military routinely uses simulation and gaming to determine potential problems before they occur in actual combat. Intensive "hot washes" or after action sessions are conducted to attempt to capture all problems that do occur in an actual or simulated event. Disaster relief forces (FEMA and the ARC) are relatively novice at such techniques.

Organizations that fail to attempt to learn suffer from failures in the organizational strategy. The organization may avoid dealing with the problem because the problem is perceived to be too complex or difficult. Or, the organization may not devote adequate resources to solving the problem, or the organization may make little attempt to implement the solution. These different modes of failing to attempt to learn all suggest that, at least from management's point of view, the problem is not being viewed as a serious threat to the organization's existence or success.

Organizations also suffer from failures in their problem solving ability or in failures in their ability to effect change. These latter two types of failure are often viewed as the result of organizational design and/or access to resources. We note that organizations often fail to learn before they even get to this point. Should organizations get to this point, these two modes of failure are, at least in principle, relatively easy to overcome. Organizations can be redesigned. More resources can be allocated to problems.

Clearly learning and passing through these stages is, at least from an objective standpoint, important to performance. Organizations that successfully navigate these stages should exhibit higher performance. Barriers to learning can occur at each of these stages. The Red Cross and FEMA in their response to Hurricane Andrew in Miami managed to successfully navigate some of these barriers and run aground on others. We list several of the issues/problems that occurred for the Red Cross (Table 2) and FEMA (Table 3) and what learning barrier each problem is associated with. As we see, the Red Cross managed in one case, staffing, to learn from previous disasters and to navigate the final barrier to organizational learning. In this case the Red Cross did learn. In two other cases, minority response and internal organization the Red Cross showed substantial improvement, but still not completely successful learning. FEMA had no clear success at any level. In two areas (roles and responsibilities and information management) FEMA had devoted significant energy to solving the problems that occurred during Hurricane Hugo and Loma Prieta, only to see their solutions fail in practice. The other two failures were, however, results of inadequate problem recognition.

\*\*\* Place Tables 2 & 3 About Here \*\*\*

Red Cross performance in Hurricane Andrew illustrates several successful instances of organizational learning and several examples of less than success. The Red Cross significantly improved their ability to staff and organize, and their ability to provide services to racial and ethnic minority groups. Damage assessment, information management, and disaster welfare inquiry were as problematic as they were in prior disasters. The scope of inter-organizational coordination problems inherent in operating under the Federal Plan was not adequately recognized prior to Hurricane Andrew and required the implementation of ad hoc solutions. The Red Cross had clearly identified the ability to staff and mobilize forces as a critical issue. The Red Cross had learned from Loma Prieta, Hurricane Hugo, and previous disasters that local chapter assistance in the establishment of a response headquarters and the pre-staging of key personnel were key factors in the rapid establishment of an effective organization. Prior to Hurricane Andrew, Red Cross managers were staged in Orlando while the Greater Miami Chapter

opened the Disaster Relief Operation Headquarters at the International Brotherhood of Electrical Workers union hall in Miami.

We would like to conclude by noting that even if the stages identified in Figure 1 are successfully navigated and the barriers overcome organizations may not gain the benefits of higher performance. As we saw in Miami, performance may not be judged objectively. Subjective performance judgments, such as those provided by the press, act as a barrier to learning and minimize the ability of the organization to successfully navigate these stages. Subjective performance judgments minimize the organization's ability to locate and implement useful change. Moreover, the existence of such performance judgments, even when they do not prevent learning, may act to deny the organization the benefits of high performance. Thus organizations, even if they do learn to perform well based on objective measures, may come under attack due to subjective measures and their longevity may be threatened.

In situations where failure free operation is expected, where the performance of the organization is under intense public scrutiny, factors affecting the subjective evaluation of performance may be of prime importance. In such situations, organizational longevity may be more a function of learning impression management than of learning how to, on some objective standard, improve their performance. Organizational survival may depend more on the ability of the organization to create the impression that it has initiated change than on actually initiating change. In such cases, organizational learning would not guarantee improved performance, but a perception of improved performance. Yet we have seen, it is generally harder for the organization to learn to cope with the environment than to cope with internal stress. It is easier for the organization to initiate changes to solve internal problems than external ones. Subjective performance judgments can be considered an aspect of the environment. Thus it is difficult for the organization to learn what to do to guarantee a perception of improved performance. Organizations in such environments are thus left in a quagmire where they move between denial (the subjective doesn't match objective, so the problem doesn't exist), educational attempts (convince those making subjective judgments of the objective standards), and ill tuned response (learning by attending to subjective instead of objective). In such a quagmire learning is neither direct nor obvious, but it does occur and it may

---

not garner the organization the benefits of improved performance. Change, even when it should be beneficial, may not be.

## REFERENCES

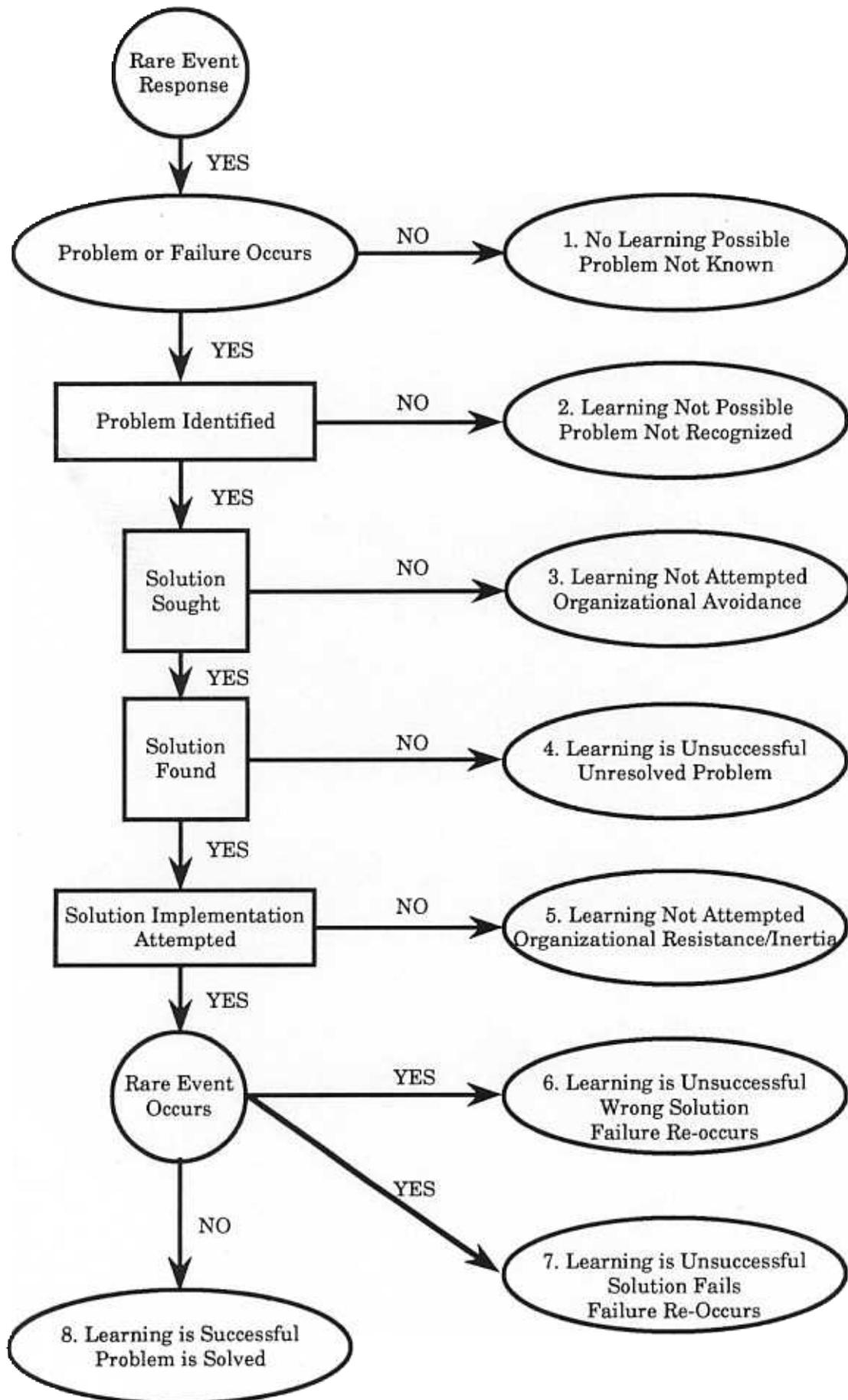
- American Red Cross. (1991). Disaster Response Assessment: Findings and Recommendations.
- American Red Cross. (1991). The New Madrid Seismic Zone Catastrophic Capabilities Seminar After Action Report. American Red Cross Disaster Services: Catastrophic Earthquake Planning and Response.
- American Red Cross. (1991). Response 91A After Action Report.
- Argote L., Beckman S. and D. Epple. (1987). The persistence and transfer of learning in industrial settings. Paper presented at the St. Louis meetings of the Institute of Management Sciences (TIMS) and the Operations Research Society (ORSA).
- Bavelas A. (1950). Communication Pattern in Task-oriented Groups. *Journal of the Acoustical Society of America*, 22, 730-735.
- Carley K., Lehoczky J., Rajkumar R., Sha L., Tokuda, H., and L. Wang. (1988). Comparing Approaches for Achieving Near Optimal Solutions in a Distributed Decision Making Environment. Working Paper.
- Carley K. (January 1990). Coordinating for Success: Trading Information Redundancy for Task Simplicity. Proceedings of the 23rd Annual Hawaii International Conference on System Sciences.
- Carley K. (1991). Designing Organizational Structures to Cope with Communication Breakdowns: A Simulation Model. *Industrial Crisis Quarterly*, 5, 19-57.
- Carley K. (1992). Organizational Learning and Personnel Turnover. *Organization Science*, 3(1), 20-46.
- Carley K. and J. Harrald. (November, 1992). Hurricane Andrew Response: Comparing Practice, Plan, and Theory. *Natural Hazards Observer*.
- Cohen A.M. (1962). Changing Small-Group Communication Networks. *Administrative Science Quarterly*, 6, 443-462.
- Cohen A.M., Robinson E.L. and J.L. Edwards. (1969). Experiments in Organizational Embeddedness. *Administrative Science Quarterly*, 14, 208-221.
- Corkill D. (1979). Hierarchical planning in a distributed environment. Proceedings of the Sixth International Joint Conference on Artificial Intelligence. Tokyo, Japan.
- Cyert R.M. and J.G. March. (1963). *A Behavioral Theory of the Firm*. Englewood Cliffs, NJ: Prentice-Hall.

- DeGroot M.H. (1970). *Optimal Statistical Decisions*. New York, NY: McGraw-Hill.
- DeGroot M.H. (1974). Reaching a Consensus. *Journal of American Statistical Association*, 69, 118-121.
- Downs A. (1967). *Inside Bureaucracy*. Boston, MA: Little, Brown and Company.
- Dutton J.M. and A. Thomas. (1984). Treating progress functions as a managerial opportunity. *Academy of Management Review*, 9, 235-47.
- General Accounting Office. (1993). Disaster Assistance: Federal, State, and Local Responses to Natural Disaster Needs Improvement GAO/RCED.
- Grofman B. and Owen G. (Eds). (1986). Information Pooling and Group Decision Making. Proceedings of the Second UC Irvine, Conference on Political Economy. Greenwich, CT, JAI Press.
- Guetzkow H. and Dill W.R. (1957). Factors in the organizational development of task-oriented groups. *Sociometry*, 20, 175-204.
- Harrald, J.R., M. Abchee, H. Alharthi, and D. Bourkari. (1991). The Development of A Methodology for American Red Cross Staffing of a Disaster Under the Federal Response Plan. George Washington University Research Report,
- Harrald, J.R., M. Abchee, D. Boukari, and S. Cho. (1990). An Analysis of the American Red Cross Staffing for the Hurricane Hugo and Loma Prieta Earthquake Disaster Relief Operations. George Washington University Research Report.
- Harrald J.R., Marcus H.S. and W.A. Wallace. (1990). The EXXON Valdez: An Assessment of Crisis Prevention and Management Systems. *Interfaces*, 20(5), 14-20.
- Hastie R. (1986). Experimental Evidence on Group Accuracy. In Jablin F.M., Putnam L.L., Roberts K.H., Porter L.W. (Eds.), *Handbook of Organizational Communication: An Interdisciplinary Perspective*. Beverly Hills, CA: Sage.
- Johnson H.T. and R.S. Kaplan. (1987). *Relevance Lost: The Rise and Fall of Management Accounting*. Boston, MA: Harvard Business School Press.
- Leavitt H. (1951). Some Effects of Certain Communication Patterns on Group Performance. *Journal of Abnormal and Social Psychology*, 46, 38-50.

- Levitt B. and J.G. March. (1988). Organizational Learning. *Annual Review of Sociology*, 14, 319-40.
- Lin Z. and K. Carley. (1992). Maydays and Murphies: A Study of the Effect of Organizational Design, Task and Stress on Organizational Performance. *Sociological Abstracts*.
- Lindblom C.E. (1959). The "science" of muddling through. *Public Administration Review*, 19, 79-88.
- MacKenzie K.D. (1978). *Organizational Structures*. Arlington Heights, IL: AHM Publishing Corporation.
- March J.G. (1981). Footnotes to organizational change. *Administrative Science Quarterly*, 26, 563-77.
- March J.G. and J.P. Olsen. (1975). The uncertainty of the past: organizational learning under ambiguity. *European Journal of Political Research*, 3, 147-71.
- Marschak J. (1955). Elements for a Theory of Teams. *Management Science*, 1, 127-137.
- McGuire C.B. and Radner R. (1986). *Decision and Organization*. Minneapolis, MN: University of Minnesota Press.
- Michael E.J. (1986). Elements of Effective Contingency Planning. Avoiding and Managing Environmental Damage from Major Industrial Accidents, Proceedings of an International Conference. Pittsburgh, PA, Air Pollution Control Association.
- National Academy of Public Administration. (1993). Coping with Catastrophy: Building an Emergency Management System to Meet People's Needs in Natural and Manmade Disasters. Report required by the Congress of the United States.
- National Fire Protection Association. (1991). The Loma Prieta Earthquake Emergency Response and Stabilization Study. Federal Emergency Management Agency,
- Nelson R.R. and S.G. Winter. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.
- Perrow C. (1984). *Normal Accidents: Living with High Risk Technologies*. New York, NY: Basic Books, Inc.
- Preston L. and E.C. Keachie. (1964). Cost functions and progress functions: an integration. *American Economic Review*, 54, 100-7.

- Price J.L. (1977). *The Study of Turnover*. Iowa: Iowa State University Press.
- Price J.L. and Mueller C.W. (1981). *Professional Turnover: The Case of Nurses*. Jamaica, NY: Spectrum Publications.
- Quarantelli E.L. (1985). *Organizational Behavior in Disasters and Implications for Disaster Planning*. Emmitsburg, MD: FEMA Publication 104, National Emergency Training Center.
- Roberts K. (1989). New Challengers to Organizational Research: High Reliability Organizations. *Industrial Crisis Quarterly*, 3(2), 111-125.
- Roberts K. (1990). Some Characteristics of One Type of High Reliability Organizations. *Organization Science*, 1(2), 160-176.
- Rosenberg N. (1982). *Inside the Black Box: Technology and Economics*. Cambridge, England: Cambridge University Press.
- Schein E.H. (1972). *Professional Education: Some New Directions*. New York: McGraw Hill.
- Shaw M.E. (1954). Some effects of unequal distribution of information upon group performance in various communication nets. *Journal of Abnormal and Social Psychology*, 49, 547-553.
- Shaw M.E. and Rothschild G.H. (1956). Some effects of prolonged experience in communication nets. *Journal of Applied Psychology*, 40, 281-286.
- Steinbruner J.D. (1974). *The Cybernetic Theory of Decision Processes*. Princeton, NJ: Princeton University Press.
- Thompson J. (1967). *Organizations in Action*. New York, NY: McGraw Hill.
- Thorndyke P., McArthur D. and S. Cammarata. (1981). Autopilot: A distributed planner for air fleet control. Proceedings of the Seventh IJCAI. Vancouver, B.C. Canada.
- Tushman M.L., Virany B. and Romanelli E. (1989). Effects of CEO and Executive Team Succession on Subsequent Organization Performance (Tech. Rep.). Presented at the NSF-sponsored Conference on Organizational Learning — Carnegie Mellon, May 18-20, 1989.
- Weber M. (1968). *Economy and Society*. New York, NY: Bedminster Press.
- Weingart L. (1989). *Group Goals, Effort, Planning and Group Performance*. Unpublished Doctoral Dissertation, Northwestern University, Evanston, IL.

**Figure 1: A Taxonomy of Organizational Learning From Rare Events**



**Table 1: Organizational Learning**

---

1. Learning not possible	Potential problem did not occur
2. Learning not possible	Problem not recognized due to inadequate feedback, intelligence, or information processing
3. Learning not attempted	Solution not sought due to organizational avoidance
4. Learning not attempted	Solution sought, but problem not solved
5. Learning not attempted	Solution found, but not implemented due to organizational resistance or inertia
6. Learning is unsuccessful	Solution implemented, but fails due to wrong solution
7. Learning is unsuccessful	Solution implementation is attempted but fails due to organizational resistance
8. Learning is successful	Problem does not reoccur

---

Table 2: American Red Cross Response

---

---

<u>Activity</u>	<u>State of Learning</u>
Red Cross staffing	7
Red Cross coordination with minority victims	
Red Cross Disaster Welfare Inquiry	5
Red Cross damage assessment	3
Red Cross supply/logistics	4
Red Cross organization	
Red Cross inter-organization coordination	4

---

---

Table 3: Federal Emergency Management Agency Response

---

<u>Activity</u>	<u>State of Learning</u>
Clarification of federal organizational roles and responsibilities	6
Inter-organizational coordination	2
Damage assessment	2/3
<u>Information management</u>	6

---