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EMPLOYING ADAPTIVE STRUCTURING AS COGNITIVE DECISION AID IN HIGH RELIABILITY ORGANIZATIONS

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INTRODUCTION

Saturday, June 15, 1996, was a seemingly normal day for the Greater Manchester Police Department (GMPD). At 9:41 A.M., however, a local television station reported a tip of an ensuing bomb threat. Suddenly, the GMPD faced a major crisis. Police officers immediately began searching for the alleged bomb while evacuating about 80,000 people in downtown Manchester. At 10:00 A.M., police located the bomb and called the bomb squad to the scene while simultaneously evacuating citizens. The bomb squad arrived 15 minutes before the bomb was set to detonate, but unfortunately failed to deactivate it, resulting in a catastrophic explosion. The city suffered major damage— a huge crater engulfed it, skyscrapers fell, and shockwaves affected structures over eight kilometers from the epicenter. Miraculously no one died, although 220 people sustained injuries and the city suffered damage equal to an estimated 700 million dollars.

Although GMPD could not stop the impending explosion, they successfully evacuated 80,000 people from a highly populated area in very little time and prevented any loss of life. The GMPD responded decisively to the threat because they could effectively integrate information from two seemingly unrelated sources. First, the local television station received a tip of a bomb in downtown Manchester (but not giving its location) close to detonation and proceeded to air the breaking news. Police remained oblivious of the situation until they saw it on the news. Second, the police had issued a parking ticket to an unusually placed truck in the center of town. Upon hearing about the bomb threat, the police were able to associate the two and immediately suspected that the truck played a role in the overall scheme. In twenty minutes, police pinpointed and confirmed the exact location of the bomb, thus giving enough time for citizens to

evacuate the city. The combination of two pieces of seemingly unrelated information allowed the GMPD to understand and handle the situation in the most effective way.

Unlike the GMPD, not all organizations are successful in preventing such catastrophes. Because key errors can interact, snowball, and cascade to catastrophic outcomes, some organizations strive for nearly error-free operation (Weick and Roberts, 1993). High Reliability Organizations (HROs) are an example of organizations that succeed in achieving low error rates in the face of potentially catastrophic loss (Roberts, 1990). The GMPD can be considered an HRO because of its adaptive responses to novel information using appropriate cognitive integration in a distributed decision making context.

One argument that criticizes this work describes HROs as an exceptional subcategory of organizations that do not necessarily generalize to the broader class of organizations. Weick and Roberts (1993), for instance, suggest that HROs focus mainly on their reliability while overlooking qualities such as efficiency that other organizations place at a higher priority. However, recent research, finds that more and more organizations operate in potentially hazardous environments with widely differing reliability ratings (e.g. Ciavarelli, Figlock, Sengupta, and Roberts, 2001; Gaba, Singer, Sinaiko, Bowen, and Ciavarelli, 2003; Madsen, Desai, Roberts, and Wong, 2006; Marcus and Nichols, 1999). With the growing influence of technology on society, Pool (1997: 276) suggests that more organizations must focus on achieving high reliability. These advances suggest that HRO research is not to be underestimated—it is an important examination of complex organizations that manage to handle challenging crises well where other organizations have failed. Organizations that desire to achieve more reliable

practices and outcomes can *glean* from and apply the lessons learned in HROs that achieve reliability in hazardous environments.

Research on HROs has identified several structural and cognitive mechanisms that support rapid and effective decision-making in crisis situations (e.g., Bigley and Roberts, 2001; Klein, Bigley, and Roberts, 1995; Roberts, Madsen, and Desai, 2005; Weick and Roberts, 1993). However, HRO research rarely touches upon how specific methods fare across organizations that are successful and unsuccessful in achieving highly reliable operations. In this chapter, we begin to fill this gap through an analysis of three organizations that operate in crisis-prone environments.

In each of these cases, *organizational structures and group mental models were adapted to facilitate effective decision making in the high-risk incidents*. Each organization, however, experienced different success rates in its attempt to attain high reliability. The first organization effectively structures and facilitates decision-making in highly hazardous situations. The second organization went from low to high reliability and then reverted to lower reliability. The third organization created a structure to foster high reliability decision making in crisis prone situations. Each organization operates in an industry environment with examples of both high and low reliability decision making.

We begin with what is known about processes contributing to high and low reliability decision making. We then discuss the three cases, covering the similar processes used in the three situations and note what managers can take from this. Finally we state the need for research that does not simply examine flexible decision making in one organization but recognizes that often various geographically distributed units are called upon to address the same problem.

DECISION MAKING CONTEXTS OF DISASTER PRONE ENVIRONMENTS

There are many examples of bad decisions in organizations that should have been highly reliable: the sinking of the Titanic, the loss of the space shuttles Challenger and Columbia, the Chernobyl crisis, and a vast number of medical accidents. There are also a number of successful cases, some of which include organizations that use structured activities to facilitate decision making, leading members to re-organize their norms, values, and rules, to search for latent errors, and to build slack to eliminate errors. Organizations in this group include U.S. commercial nuclear power plants, the U.S. Navy carrier aviation program, and some health care settings. To illustrate, Weick and Roberts (1993: 357) suggest that although naval aircraft carriers "represent 'a million accidents waiting to happen' (Wilson, 1986: 21), almost none of them do."

The successful and unsuccessful organizations share similar operating environments. Many organizations operate in dangerous situations with high levels of uncertainty and risk. Members of each organization perform in situations requiring a high degree of reliability because of the risk of poor outcomes. What, then, determines success versus failure? Perrow (1984) classifies organizations and systems based on their degree of complexity and on the degree to which organizational elements are integrated. Interactively complex systems, according to Perrow, are those in which two or more discrete failures can interact in unexpected ways that potentially have a complex and unpredictable effect on the overall system. When parts of these systems are tightly adjoined, or lack slack to minimize errors, problems that arise tend to exacerbate and may even be made more complicated rather than be solved by operator intervention.

Turner's (1978) Disaster Incubation Model (DIM) gives one explanation of how poor decisions occur and accumulate in these organizations. Four of Turner's six steps in the DIM refer to the emergence of poor decision making: 1) starting point, 2) incubation period, 3) precipitating event, and 4) onset. The starting point in an organization involves culturally accepted views associated with an organization's processes, rules, laws, codes, and procedures designed to ensure safety against danger. The incubation period is a time in which small mistakes add up to something greater. The incubation period is a series of events that are at odds with the organization's norms and beliefs. These discrepant events represent times during which organizations could detect and change the flaws of their models and procedures.

In organizations headed for crisis, however, these incubating events are neglected, noticed but misunderstood, or noticed but not taken care of adequately. These incubating events indicate latent failures in an organization's system. Latent failures weaken an organization's defense system before any significant accident transpires. Latent failures usually go unnoticed until they interact with some precipitating event, an event in which conditions that normally pose little threat begin to act in unexpected ways. Precipitating events are small errors, a set of abnormal situational conditions, technical problems, or such insignificances. However, in concert with latent failures, precipitating events can lead to regrettable disaster.

Turner's (1978) disaster incubation model suggests that a cyclical process takes place in organizations facing hazardous situations. This sometimes recursive, and unstructured process deals with error incubation and detection, decision-making involving potential solutions, and disastrous or mitigated outcome events. The process

model suggests that not all tightly-linked, highly complex systems are all accident prone as Perrow predicted (1984). Instead, organizations may build redundant structures, build up slack resources, and create other processes to improve error rates and overall decision-making in situations demanding high reliability.

EMPLOYING ADAPTIVE STRUCTURING AS A COGNITIVE DECISION AID

Research on HROs identifies structures and processes that guide cognitive evaluation and decision-making in cases requiring high reliability. In resorting to structural adaptations and procedures, organizations as systemic entities can scan their environments expansively, examine their operations microscopically, and respond to changing contingencies rapidly. Structural adaptations allow organizations to become more than the sum of their parts. Enhanced cognitive coherence is achieved when the organization as a system compensates for inevitable myopia that an individual decision maker suffers. Providing some cognitive theoretical underpinning behind the HRO research helps illustrate how decision makers rely on structural processes as cognitive decision aids to achieve systemic advantages.

Treating organizations as interpretation systems, Weick and Daft (1983) see them as connected networks, where members congregate and share information, or engage in sense-making, to understand what has transpired. Sense-making is the process by which organizational members create mental models of the organization and its environment (Weick, 1995). Organizational members typically do not hold the same mental models of the organization, though they do share some similarity and compatibility from constant interaction (O'Connor, 1987).

The overlapping mental models facilitate decision making in high reliability situations by letting members cooperate in the pursuit of similar goals. By sense-making, organizational decision makers can interpret their environments in ways that reduce the uncertainty in hazardous or quickly unfolding events because they draw from information across varied intra- and inter-organizational networks. Therefore, organizational decision makers can artificially stretch time and shorten reaction time by reducing the time required to gather, interpret, and verify information regarding situational understandings (Roberts, 1990).

Organizational decision makers' overlapping mental models of their technological environments are usually developed slowly through environmental interactions to fit with conditions normally facing the organization (Weick, 1995). Slow and familiar changes in the environment can be reconciled with these mental models, while rapid and unfamiliar changes, and particularly changes to the nature of crises posed by the task environment, cannot be reconciled (Weick, 1993). For this reason, organizational members experience dangers as stunning, scary, and incomprehensible and may become rigid in the face of peril (Perrow, 1984; Staw, Sandelands, and Dutton, 1984).

Effective decision-making in huge crises beg organizational members to quickly develop new mental models of situations as they evolve. However, due to the difficulty of such a task, people cling to existing models as long as possible, selectively processing information that confirms existing models instead of updating them (Louis and Sutton, 1991; Weick, 1995). Cognitive rigidity not only leads to delay in decision making but also misinterpretations of information due to the erroneous mindset. When subject to

extreme rigidity, people abandon existing mental models give up hope of understanding the threat, and (sometimes literally) run for their lives (Weick, 1993).

Recognizing anomalies or latent errors before the crisis is key to effective decision making that achieves high reliability (Marcus and Nichols, 1999; Ramanujam and Goodman, 2003). When encountering anomalies, successful decision makers reconsider or revise their understanding of the situation. In the Manchester bombing, the bomb threat forced the police to reappraise the anomalous, illegally parked van as a potential bomb location, instead of as another common instance of illegal parking. The ability to reexamine anomalous events as the situation changed illustrates heedful sense-making during crisis.

Despite the importance of sense-making, most organizations are poorly equipped to find and use information in ways that enhance reliability in decision making (Weick 1995). Over time, organizations adapt to the requisites of their environments. As part of this process, organizational members learn which sources of information about their environments are most useful in performing their daily functions. When useful information sources are known, organizational members usually monitor them closely while ignoring other information. This process is adaptive because monitoring information sources is costly and organizations are then more efficient by paying attention only to information sources that are most useful under normal conditions (Starbuck and Milliken, 1988). With time, organizational members become used to ignoring most information about the environment, especially information suggesting that radical or discontinuous changes are transpiring (Audia, Locke, and Latham, 2000).

While selective information processing is efficient under normal conditions, it is very *in*effective for decision making when situations with probable catastrophic outcomes arise. These situations push organizations toward more unfamiliar environments (Dutton, 1988). Information gathering routines that previously brought high efficiency under normal conditions no longer provide organizations with enough information to make sense of the unfolding scenario. This complicates decision making by reinforcing the use of inadequate information. When organizational decision makers do not understand that the environment is changing, they get increasingly decoupled from reality and fail to change the way they make decisions until disasters strike. The reactive mode rather than the preemptive decision making mode follows, substantially increases the likelihood of mistakes.

Although sense-making is usually an unconscious process, leaders can structure their organizations and train employees to make rapid sense-making possible when confronted with a dangerous situation (Weick, 1995). Organizational members must create new mental models and discover ways to integrate their individual mental models, so action is coordinated, and rigid and selective information processing is avoided (Roth, 1997). Since hazardous situations are often highly uncertain, organizational members must readily abandon one model in favor of another upon the discovery of new information or a change in environmental conditions (Bigley and Roberts, 2001).

Weick and Roberts (1993) developed the idea of "collective mind" to elucidate how some organizations can successfully maintain shared mental models in dangerous and quickly changing conditions. Collective mind is "a pattern of heedful interrelations of actions in a social system. Actors in the system construct their actions (contributions),

understanding that the system consists of connected actions by themselves and others (representation), and interrelate their actions within the system (subordination)" (Weick and Roberts, 1993: 357).

In order to establish collective mind in an organization, members must understand that their actions are connected. Members must also create their mental models and select their actions with connectedness in mind. This connectedness allows organizational members to mitigate hazardous conditions as they unfold. Weick and Roberts point out that "As heedful interrelating and mindful comprehension increases organizational errors decrease" (1993: 357).

Organizations facing dangerous situations are often not effectively structured to assist collective mind and continuous sense-making. While some organizations foster heedful interrelating and create methods to revise mental models as crises unfold, other organizations try to do so but discover that applying their decision making rubric fails to enhance decision making during catastrophes or improve reliability. Below, we provide three examples of organizations that operate in hazardous environments and were not all together successful in incorporating procedures to help decision making in incidents requiring high reliability.

THREE APPROACHES OF ADAPTIVE STRUCTURING IN HROs

First, we observe the Incident Command System (ICS) used by firefighters to assemble and control complex temporary systems (Bigley and Roberts, 2001). This system is effective at combining information to facilitate decision making, expanding in scope as incidents escalate in complexity, and resetting as situations change or are resolved. Second, we examine the case of a pediatric intensive care unit (PICU) that tried

to achieve highly reliable operations by spreading decision making authority, and was successful for some time until the unit withdrew the strategy (Madsen, Desai, Roberts, et al., 2006). Third, we look at a police department's 911 call system. Although routinely effective, the system experiences both failures and successes. Examination of the system's structure shows how it is designed to decrease the consequences of failure by retaining flexibility as situations evolve (Roberts, Madsen, and Desai, 2007).

The Incident Command System (ICS) in a Large County Fire Department

Bigley and Roberts (2001) investigated the operation of the Incident Command System (ICS) in a large county fire department that serves the county government and its constituent cities. Serving a population of over 1.2 million and a jurisdictional area that covers more than 560 square miles, the department contains sixty plus fire stations located in the county's major geographic divisions. Each division consists of a number of battalions that in turn are broken down into stations. In total, the fire department hires over 800 full-time firefighters and has 700 firefighters on call.

The ICS builds and provides a very rigid structure on site at each emergency. In order to respond effectively to any emergency situation, it has to retain a sense of internal and external malleability as circumstances unfold and change. This organization faced several challenges: 1) how to make the ICS more malleable; 2) how to get away from centralized decision making to meet the challenges of a constantly changing situation; and 3) how to provide tools organizational members may use that assist in the decision making fabric similar to that of heedful interrelating. To perform these tasks, the ICS developed four structural processes that Bigley and Roberts (2001) label as structure elaborating, role switching, authority migration, and system resetting. The ICS is a

standard hierarchical organization. In response to most emergencies, the challenge is to avoid overbuilding the organization, which might result in providing more structure than needed by the crisis.

Incident commanders need to be vigilant to the likelihood that the system they create might fail to conform to the situation's needs. As the emergency abates, commanders can disengage parts of the system as they become excessive. They breathe malleability into the system in many ways. One way involves considerable role switching, where team members take on different positions during different times in the crisis. Role switching involves the assignment and reassignment of personnel to different roles within the organization depending on the organization's needs. Role switching complements structure elaboration.

Authority migration also builds in flexibility and takes place when the incident demands it. Different emergency responders are schooled in emergency medicine, hazardous materials handling, urban search and rescue, as well as construction or chemical processing. Informal decision-making authority is often explicitly unlinked from the official hierarchy and travels quickly across ICS positions to individuals who have the expertise to solve particular problems.

In order to respond to quickly changing situations, the entire structure may have to reset itself to regain hierarchical flexibility. Sometimes an incident commander will discover that his initial organizational form is not solving the problem or he is given a "nasty surprise." The prudent thing to do is to disengage and reset the structure to effectively confront the new or changing problem.

These structural processes are implemented to inject fluidity into the decision making process. According to Bigley and Roberts (2001), they are helped by constrained improvisation and cognitive management methods, both processes lending even more fluidity to the situation. Supervisors may not understand enough about the contingencies of the local situations facing subordinates to provide sufficient direction. Also, since each emergency situation is unique, task environments often outstrip the experience base of those people in the ICS. Thus, supervisors often have considerable discretion in the extent to which they give detailed instructions to subordinates. When subordinates gain sufficient experience, training, and resourcefulness to adapt to local conditions, the supervisor frequently leaves the task partially unstructured, and provides subordinates with enough discretion to improvise. This strategy increases the chance that the decision will be specifically appropriate to the problem.

In order to effectively address emergencies, team members spend much time developing cognitive representations of the situation and altering those representations as the world changes. They are engaged in ongoing "size ups" which are communicated across team members. Developing high fidelity models and communicating them assists team members in coordinating decision making that reflects the nature of the problem. Accurate and timely communication is integral to reaching this goal.

As representations are developed and communicated, they are also embedded within the system in terms of scope and detail. This embedding is frequently consistent with the lines of authority such that people at the top of the organization have more scope and those closer the bottom have more detail. Detail has to be enmeshed with scope, more conventionally known as "having the big picture," or "having the bubble." This is

synonymous with Weick and Roberts' (1993) notion of collective mind since leadership is able to amalgamate details from across the organization to arrive at a comprehensive understanding of the environment as crises unfold, and use this understanding to mold decision making under uncertainty, time pressure, and complexity.

The Pediatric Intensive Care Unit (PICU)

Madsen, Desai, Roberts, and Wong (2006) report on the creation of a Pediatric Intensive Care Unit (PICU) to treat severe and chronically ill youth in a metropolitan area. Both complex and unpredictable, pediatric intensive care performs a myriad of delicate procedures, some as minor as injections or intravenous line insertions that could cause patients to become agitated and move in unpredictable ways. To meet the challenges of treating children in critical condition, a metropolitan hospital created a new PICU in 1988 that serves a population of 2.5 million with 20% under the age of 15 and a geographic size of Vermont tripled. In 1988 the hospital employed a pediatric intensivist as the director of the new PICU, with a second intensivist joining the unit a year later. These two physicians lead the unit until 2000, when they both left the hospital. During their tenure, the PICU grew considerably in terms of beds, equipment, patients, and admissions to become one of the biggest PICUs in the United States

The first intensivist noticed a sharp distinction between the bedside caregiver, typically a resident nurse who monitors small groups of patients within close proximity, and the physician who attends to a larger group of patients but allocates less time to each. Since bedside caregivers spend more time with patients, they are the first organizational members to notice changes in patients that may signal health problems. On the other hand, the intensivist noticed that physicians relied on information from laboratory values,

radiographic findings, and physician colleagues as resources to make effective decisions, but often neglected information from nurses.

The intensivist wanted to design an ideal unit that involved nurses in making patient care decisions and avoided the mistakes that potentially emerge from selective information processing. When the PICU began admitting patients, the intensivist began asking nurses for their insights on patient treatment options and inviting them to perform some tasks usually assigned to doctors. At first nurses disliked this approach because their responsibilities seemed to increase; furthermore, they thought the approach implied that the physicians were incompetent. This initial reaction surprised the new PICU director persuading him that instituting his desired participative organizational design in the unit needed a long-term commitment and evolving effort.

As the intensivist continued encouraging nurses to help make patient care decisions, many dedicated nurses (and later the dedicated respiratory care practitioners) began warming to his proposal. At this point, participative decision-making in the unit was not formal and largely involved queries for staff members', observations about patients and requests for their views about effective treatment routes. Several nurses and respiratory care practitioners working in the unit reported that the intensivist's approach made them feel valued, yet under qualified to give suggestions on patient treatment options at that time. In response, the intensivist started assisting staff members in medical decision making. He introduced information through conversations with care staff and continued to invite staff members to attend the physicians' rounds.

Due to prior experience with a decentralized approach in other workplaces, the second intensivist enthusiastically supported the PICU director's push to delegate care

decisions to nurses, respiratory care practitioners, and residents. While the first intensivist conducted informal lessons, training became more formalized after the second intensivist's arrival. The intensivists started showing staff members how to identify medical problems that brought children to the PICU. They taught caregivers how to spot and treat symptoms that could arise because of disease or inappropriate medical care. The intensivists also gave staff members formalized decision making aids to help them know when to treat a patient themselves and when to ask for help. They taught staff members to categorize patients' symptoms, assess the severity of the category, and begin treating the most acute symptoms while calling for additional help if necessary.

Both intensivists taught informally when opportunities arose, but also started formal in-service training lessons for all staff members. The intensivists encouraged staff members to read medical journals and textbooks to enhance their education. Some former nurses and respiratory care practitioners said that they became so interested in what they were learning in these sessions that they decided to return to school for advanced degrees. With more training, staff members felt more comfortable accepting responsibility and the two intensivists delegated more authority to them. However, specialists from other hospital departments were not used to such a degree of decentralization. Despite this, the PICU directors created a policy to always support staff members' decisions in these situations. While staff members' decisions were far from infallible, the two PICU intensivists felt that their decentralized design improved response times and decision quality on average because staff with more direct information about critical situations made more effective care decisions. They felt that distributing decision-making authority

reduced the need for information to flow through the chain of command and back to the bedside caregivers, substantially enhancing the speed of responses

The unit's decentralization met with opposition from some staff members. While most of the staff at least cooperated with the decentralized approach, it needed a large commitment by staff members to learn how to carry out new duties. However, internal opposition to the decentralized design was not nearly as strong as resistance from other hospital departments. Those from other departments increasingly discussed the PICU's design and processes with the intensivists, at times to advise the intensivists of resistance from administration, and at other times to argue that staff members made poor care decisions. Hospital administrators and some physicians in other departments also saw the decentralization approach as a waste of time and resources.

With the implementation of decentralized decision making, the PICU experienced a noticeable decrease in mortality rate for a PICU its size even while the unit was growing rapidly. By 1993, the PICU's mortality rate was 4.6% compared to the average rate of 7.8± 0.8% for PICUs of relative size (Madsen, Desai, Roberts, et al. 2006). In 1999, the last year that the original intensivists remained at the unit, its mortality rate was 3.5%. Several other indicators of patient medical outcomes also appeared to improve, such as the introduction of several medical innovations that improved health care. An illustrative example of an innovation involved respiratory care practitioners and how they changed treatment for severe asthma through altering the blend of helium and oxygen when administering gas to patients. Such innovations would not have been possible without the medical training employed by the PICU intensivists' decentralized decision-

making approach. Bedside caregivers reported more satisfaction among staff in the decentralized unit compared with other medical settings.

With the unit growing, more doctors were hired until the unit stabilized at five. Until 1997, the only physicians assigned to the PICU were supporters of the decentralized approach, an unorthodox yet effective design. Beginning in 1997, however, intensivists trained elsewhere were assigned to the unit. Some of these externally trained intensivists failed to see the value of the PICU's approach and thought that the unit's design might constitute malpractice because physicians in the unit were not always in control of patient treatment. The new intensivists advocated strict physician authority and one-way, downward communication, expressed concern for malpractice liability on the part of physicians inside the PICU, and possessed generally negative feelings about the unit which resonated with physicians' feelings in other hospital departments. Some hospital administrators even argued against the allocation of resources to support the unit's continued expansion. In such a resistant environment, both of the original intensivists left the hospital to accept positions elsewhere in 2000.

The structure of decision making changed after the departure of the two original intensivists according to remaining staff members in the PICU. Decision making eventually took the path of tradition where physician authority overruled bedside caregiver suggestions and patient care decisions. The new physicians did not encourage staff members to participate in rounds and no longer used rounds as an opportunity to train nurses. Although current staff members do not doubt the competence of current PICU intensivists, they suggest that health outcomes have generally declined since 1999. Statistics show that the annual mortality rate at the unit has increased since then. Staff

turnover has increased during the same time period. The PICU seems to have lost some measure of reliability since the departure from the decentralization approach advocated by the original intensivists prior to 1999.

Big City Police Department

Roberts, Madsen and Desai (2007) examined the interactions between sense-making and decision making in a large police department they dub Big City Police Department (BCPD). BCPD serves a large urban metropolis inhabited by about 380,000 people, investigating in excess of 100 homicides annually (one of the highest totals per capita in the United States). In 2000, each of this department's emergency response phone line (#911) operators responded to an average of 17,000 calls, branding itself as the highest level of emergency operator activity of any large U.S. city.

BCPD is a paramilitary organization that defines itself along bureaucratic military lines. However, emergency dispatchers and police officers are given a great deal of discretion in handling emergencies. Information coming into the communication center travels across at least four different individuals. Citizens make emergency calls to report a crime or to request police assistance. Complaint operators respond to and evaluate citizen calls. If a call requires police assistance, they note pertinent details in a computerized format and electronically transmit important information, such as the level of urgency priority, to dispatchers.

Upon receiving information from complaint operators, dispatchers re-evaluate the calls and may change a call's priority level if deemed appropriate. Dispatchers allocate available resources to handle the calls, communicate with officers through primary police radio channels to make assignments, and monitor police response to calls. In emergency

crises, complaint operators send preliminary information to dispatchers while continuing to question callers for further information. Thus, complaint operators and dispatchers are in constant contact through the communication center's computer system. Dispatchers also maintain contact with police officers through the event's duration. Call takers and dispatchers are responsible for making sense of incoming 911 calls and letting police officers know what to expect when they arrive at the scene. The two primary goals at BCPD are citizen and police safety. Consequently, BCPD has created methods that allow emergency dispatchers and police officers to make the best possible sense of hazardous situations so that police officers can respond effectively to protect citizen safety while placing themselves in the least amount of risk possible.

Roberts, Madsen and Desai (2007) conducted an archival review of 32 adjudicated homicide cases that were sent through the 911 system. Homicides are delicate situations that can either be handled reliably by the police, or may result in further death. This review illustrates, through the portrayal of cases in which callers minimized or withheld valuable information, the complexity of the call taker's job. Other callers explained their understandings of the calls based on incomplete information; these callers often gave accounts that made sense of what they witnessed about the situation, but did not suggest that a homicide had transpired. Reports of the same incident by a number of people from different perspectives, the changing nature of the incident over time, and the increasing number of first responders can make call takers' jobs more complex.

Roberts, Madsen and Desai (2007) noted a number of regularities in the way police addressed calls. They call these "practices": early model adoption, model

migration and resetting, and having the bubble. First, even if there is vague and confusing information from the beginning of a call, call takers assign a priority code and an identifying code to the situation as they handle the call. This practice provides an integrative framework police use to coordinate information and comprehension. It is the beginning of a working shared model that can evolve over time. This early model adoption, however, became problematic in several cases where the initial model was incorrect but adopters kept it beyond its usefulness. While early model adoption is usually a heuristic to problem solving, it can be deceiving if it leads observers to generate inaccurate conclusions about the incident. Therefore, although BCPD developed a procedure to facilitate the early sharing of mental models, this procedure made mental models hard to revise in some cases as situations developed.

However, early adopted models were appropriately customized with updated situational understandings in some cases. This is referred to as model migration and resetting. Model migration is characterized as the process through which each individual related to a case contributes information to the working mental model and then transmits it to others who may integrate that information with their own to further modify situational awareness. Model resetting materializes when the model is either revised or abandoned based on a developing understanding of the unfolding situation. Although the adoption of a model allows people to share information and coordinate actions in an integrative effort, they each have unique information that can assist in sense-making.

Roberts, Madsen, and Desai (2007) proposed that a key structural design existed at BCPD that allowed the adoption of early mental models yet helped with model migration and resetting when situations escalated or transformed. This flexibility in

modifying shared mental models emerged because dispatchers were centrally located and primarily assigned with the responsibility to receive, interpret, and share information across the organization as situations unfolded. In any potential crisis, each organizational member has a unique perspective of what the crisis is and how it is changing. These local views are important, but they must be integrated with an outsider's view, particularly one that can see the overall picture.

Heath and Staudenmeyer (2000) propose that organizations decrease effectiveness when their participants focus on partitioning complex tasks and concentrate on their individual components with a tunnel-like vision but fail to pay attention to reintegrating the tasks, taking a step back, and taking in the entire picture. As hazardous situations develop, environments change so rapidly that decision makers constantly lack information from disparate areas of the organization. One individual must be able to see the big picture or have the bubble in order to coordinate courses of action successfully. In most large U.S. police departments like BCPD, dispatchers are expected to have the bubble because they are placed centrally in the crisis response hub. Call takers direct information from callers electronically to dispatchers so that dispatchers gain access to relevant information from bystander reports. This is more efficient than directly placing callers in touch with dispatchers, since call takers are assigned the task of carefully screening out pertinent knowledge from often ambiguous and uncertain calls. Conversely, dispatchers work with police officers via radio to relay information from callers regarding developing incidents. Dispatchers are therefore in a position to collect information from call takers and police officers, and to utilize this information to coordinate police officer movements and facilitate organizational sense-making as events transpire.

DISCUSSION

Adaptive structuring processes, as illustrated in the three examples, provide many lessons that organizations can glean to achieve more reliable practices and outcomes. These lessons should not be blindly applied because organizations operate in different decision environments, face varying hazard levels, and cope with changing resource constraints. Comprehension is key: understanding how mistakes can happen in disaster prone decision contexts and grasping how adaptive structuring can operate as a decision aid that caters to the changing needs.

All three cases describe organizations in industries characterized by fairly hierarchical structures, but each case describes an institution with adaptive structuring processes designed to remove the rigidity originally associated with its hierarchical nature. Adaptive structuring thereby facilitates malleable decision making processes.

The ICS first elaborates its structure to meet the size of the emergency; larger emergencies generally demand more complex structural elaborations.. However, the ICS insures various skills held by different people will come to the fore by encouraging role switching and migrating decision making to experts. To control against going too far down an incorrect path, the system includes a resetting mechanism. The PICU realized similar high reliability outcomes by using lower level people to make decisions usually made at higher levels. They underscore this process by giving care givers formal decision making aids to help them decide when to treat and when to ask for help. However, after a period of success, the internists were encouraged to leave and elements of the old system were reinstated. BCPD accomplishes high reliability decision making through a similar process. The structure connects one or many citizen callers with one or

many call takers who try to separate relevant from irrelevant information, passing relevant information along in the organizational network.

All three reliability enhancing approaches have designed mechanisms for integrating information across organizational networks. The ICS does this through its three structural mechanisms. Structure elaboration and its opposite, structure degeneration, pertain to the need to be responsive to local condition changes, as do role switching and resetting. The PICU operates in much the same was as U.S. Navy aircraft carriers (Roberts, 1990) ensuring that the decision making structure has in it someone with the "big picture" who can allocate resources with broad discretion. BCPD has a decision making structure that allows for information reinterpretation over time with call takers and dispatchers acting as tier one and tier two in the information filtration process. Sometimes the sense of the information is still misinterpreted as it reaches the police officer on the beat. His or her knowledge of the local situation can add important data to the interpretation process. Continuously, meaning is negotiated and activities are accommodated according to changing situations.

The three field studies offer insights about how decisions are made in situations in which people in the same geographic region respond to critical events. Similar processes are used in each situation but they are modified to meet the situation's special constraints. We advise managers that achieving high reliability operations requires tailor-making management practices to the situation. Whatever processes are decided on, managers must remain flexible to meet changing situational contingencies.

We know from examples like Hurricane Katrina and the Southeast Asian tsunamis that geographical distribution puts additional stress on decision makers. Not

only are we facing more natural disasters that must be addressed from geographically disparate locations, organizations themselves are spreading far and wide in a global economy. Some research points to the role of inter-organizational relationships in creating and attenuating disasters. For instance, Turner's (1976) Disaster Incubation Model argues that potential accidents begin as minor failures that are complicated unknowingly through relationships among multiple and often dispersed organizations, until a triggering event (often the accident itself) causes direct intervention. However, more research is needed to understand how people in such distributed situations can best amalgamate information to make decisions in constantly changing and potentially hazardous situations.

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