EMS & HIGH-RELIABILITY ORGANIZING

BY **DAVED VAN STRALEN,** MD, FAAP
& **THOMAS A. MERCER,** RADM, USN, RET.

Achieving safety & reliability in the dynamic, high-risk environment

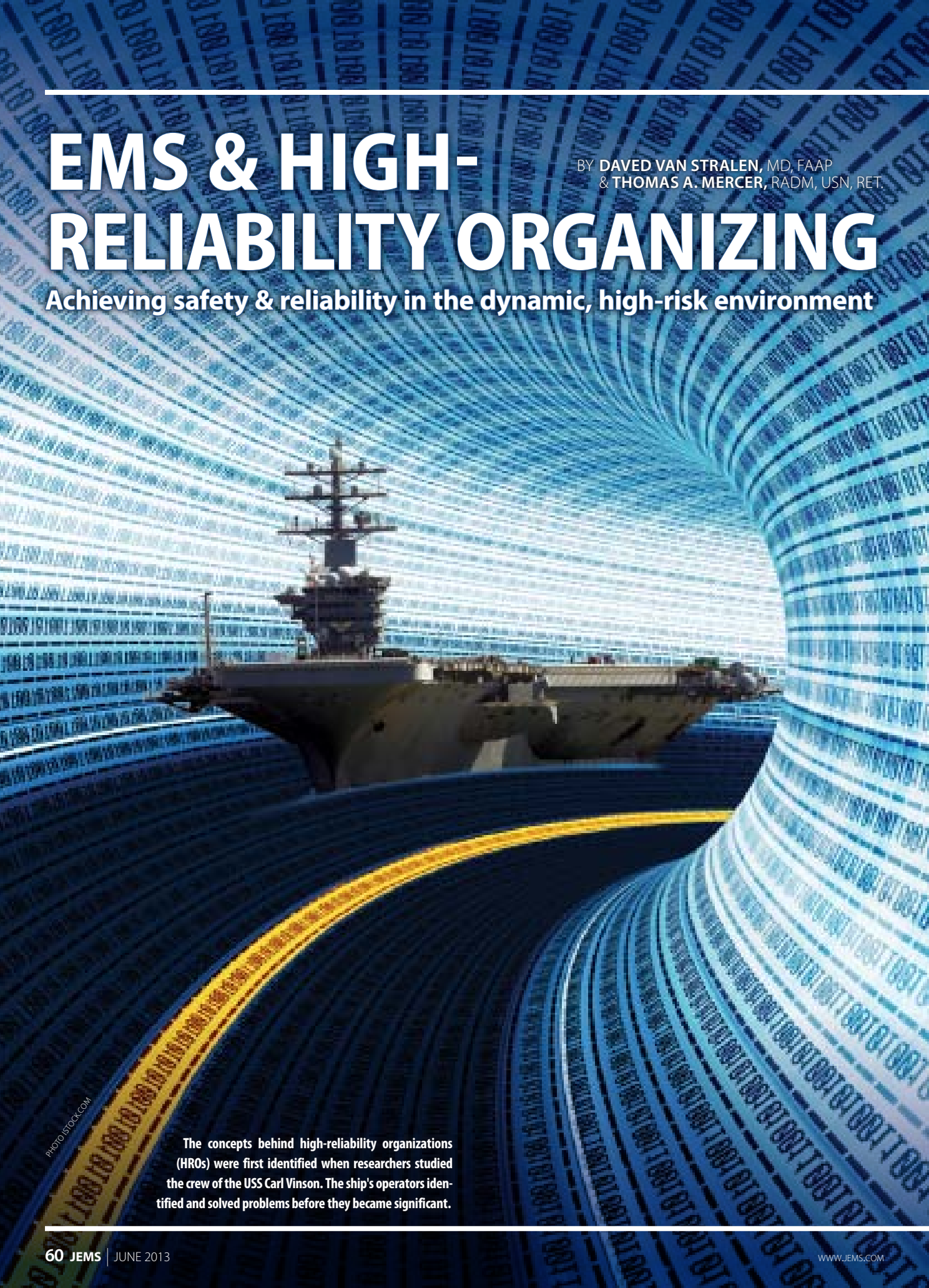

PHOTO ISTOCK.COM

The concepts behind high-reliability organizations (HROs) were first identified when researchers studied the crew of the USS Carl Vinson. The ship's operators identified and solved problems before they became significant.

Systems today, particularly those like EMS that are tightly linked between human actions and technology, have become complex to the level that accidents are not only predictable, but they can be expected. Charles Perrow described this as Normal Accident Theory after he studied the Three Mile Island nuclear power plant incident.[1]

A few years later, academics from the University of California, Berkeley were studying the notion that "accidents" in high-risk environments can be considered "normal." They came across the aircraft carrier USS Carl Vinson. Thomas A. Mercer, who was the carrier's captain, invited the Berkeley researchers to study his crew for methods to improve their performance.

According to a personal communication by Karlene Roberts, PhD, the Berkeley team found an efficient team of operators who solved problems before they became significant; the team was unable to identify areas requiring significant improvement. Therefore, they codified the methods as indicative of a high-reliability organization (HRO) and found an exception to the idea that it was normal for consequential errors to occur in high-risk environments.[2] From their studies, they codified the ship as an HRO due to its organization.

HROs are defined as organizations where significant failure or catastrophic events are rare despite operating in hazardous environments. This definition is useful for research and the identification of principles and concepts.

The operators of the USS Carl Vinson used these principles for the purpose of improving the crew's performance in uncertainty and threat, while at the same time strengthening their organization. To do this, they instituted and used specific attitudes, behaviors and beliefs. They also evaluated themselves using well-defined reportable incidents or problems.

HROs can be found not only in U.S. Navy aircraft carriers, but in EMS as far back as the 1970s. In 1980, author Daved van Stralen enrolled in medical school after experience as an "ambulance man," including paramedic training, for a private ambulance service and the Los Angeles City Fire Department. He used his knowledge of working under uncertainty and threat throughout his career and as he assisted in development of a pediatric intensive care unit. Karlene Roberts, one of the UC Berkeley academics, heard about van Stralen's use of 1970s EMS in healthcare and described his work in several articles. Later, Karl Weick included his experience in his writings.

TRANSIENT RELIABILITY

Reliability is transient. It's like a moving target because it is a localized accomplishment and specific to situations. In one study on transient reliability, reliability is described as a dynamic non-event, one that is constantly moving and changing though nothing seems to happen.[3] For example, think of how riding a bicycle requires constant balance. Events, like bumps in the road, constantly interrupt balances in the system. These interruptions require continuous management to restore balance. This means reliability is a *process* and is constantly being reestablished.

Because EMS is partly a public safety service, it responds to dynamic events in hazardous conditions. EMS also operates in an austere environment that is often without the staffing and resources thought necessary to properly stabilize and treat critically ill or injured patients. In structure and dynamics, EMS differs little from a space shuttle, nuclear power plant, commercial jet or operating room. Catastrophic failure in these similar environments includes the Challenger and Columbia shuttle tragedies, the Three Mile Island incident, the Tenerife and Potomac River jet crashes, and wrong-site surgeries.

In structure and dynamics, EMS differs little from a space shuttle, nuclear power plant, commercial jet or operating room.

The concept of HRO has helped academicians, government regulators, system managers and operators better understand catastrophic failure and improve each of these systems. Failures in each system have significantly decreased through application of HRO principles. The experience of U.S. commercial aviation further shows this reduction in failures also reduces daily financial costs, not from fewer air crashes but from more efficient and productive daily actions.

Just as the concepts of HRO can be attributed to better efficiency and production in the aviation industry, they can also describe our failures in EMS. A catastrophic event in EMS is a potentially preventable death or disability. Significant failures include increased injury, longer hospital admissions and patient injuries resulting from our treatments.

It's critical to remember that the concepts of high-reliability organizations came originally not from academic research but from codification of a command philosophy and modern leadership methods.

THE FIVE HRO PRINCIPLES

EMS can move toward high-performing, stronger systems within current constraints through the use of HRO concepts and principles. Better sensemaking, problem solving and collaboration methods based on HRO are instrumental for the time-compression and uncertainty of the EMS scene.

Social psychologist Karl Weick, PhD, and Kathleen Sutcliffe, PhD, codified five principles of HROs in *Managing the Unexpected*.[4] These are:

1. Preoccupation with failure;
2. Reluctance to simplify;
3. Sensitivity to operations;
4. Commitment to resilience, and
5. Deference to expertise.

We'll discuss each here.

HRO Principle 1: Preoccupation with failure. Ignoring small failures leads to cascading failure and larger, catastrophic events. HROs are organized to respond to early heralds of failure, and individuals in the HRO are vigilant to failures in the covert, physiologically compensated state. For example, before a patient enters obviously identifiable hypovolemic shock, there's a period, no matter how short, of asymptomatic hypovolemia. Respiratory failure is also a process with mild findings of nasal flaring and tachypnea preceding hypoventilation and apnea.

>> CONTINUED FROM PAGE 61

HRO Principle 2: Reluctance to simplify. When we accept simple diagnoses, we stop looking deeper or further. HROs are reluctant to accept these simplifications. EMS is an environment of ambiguity, complexity and imperfect information. To perform in this environment, it becomes necessary to simplify. But HROs recognize the risk of simplification, hence the term "reluctant." You simplify because you choose to, not because it's easier or your only method of analysis.

HRO Principle 3: Sensitivity to operations. Taking frontline operations for granted, not supporting them and not accepting the complex interactions necessary to work in dynamic, hazardous environments contributes to avoidable failures. The frontline performs the real work in an HRO. It's where the "big picture" is less strategic and more focused on the changing situation. This requires the free flow of information, something most easily lost when crews have a fear of speaking up or giving disconfirming evidence when it's present.

HRO Principle 4: Commitment to resilience. Resilience is the ability to maintain or regain a dynamically stable event. Neglecting the capabilities your EMS system or personnel have for resilience contributes to an inability to work problems to completion. As a situation unfolds, the demands may exceed the performance of individuals or the system. To continue operations, the organization must identify errors early for correction while also improvising workarounds within constraints of the environment.

HRO Principle 5: Deference to expertise. An HRO reduces the authority gradient that interferes with communication and facilitates migration of authority to those with the knowledge to make the best decisions. Deferring to authorities, especially because of higher status or rank and rigid hierarchy, disrupts use of local or situational knowledge and subject matter experts for anticipation and containment of a situation. In dynamic, high-risk situations, circumstances will change—and may change significantly—while information is reaching a distant, higher authority. There are those with intimate knowledge of the circumstances, those with expertise in the necessary subject matter and those with command experience who must make rapid decisions with short feedback loops to modulate actions.

MINDFULNESS

There are other characteristics of HROs that we believe are necessary for an HRO to be operational. They include collective mindfulness, sensemaking and enactment. Karl Weick developed the idea of collective mindfulness from the description of mindfulness by Ellen Langer, PhD.[5] Langer distinguishes mindfulness from mindlessness by the following five features:

1. Create new categories on the spot. People in HROs aren't trapped by preconceived categories. Mindfulness creates new categories with new information and therefore avoids the trap of placing information into rigid categories. In EMS, fire and rescue operations, normal evacuation distances may not fit under all circumstances. If you have an oil tanker leaking fuel, an evacuation distance of several feet may be appropriate. However, if you have a tanker leaking freon, that distance will change.

Just as the concepts of HRO can be attributed to better efficiency and production in the aviation industry, they can also describe our failures in EMS.

2. Welcome and use new information. Don't fall back on automatic behavior. After reaching a conclusion, it becomes easy to search for information supporting the conclusion, called confirmation bias, and disregard or discount conflicting information. Authority gradients, when a person with authority suppresses disconfirming information, can be deadly and often occurs in low-reliability organizations.

3. Use more than one point of view. Don't act from a single perspective, such as thinking everything is a rule or category. In the dynamic environments of EMS, with limited ability for any one person to see the big picture, multiple points of view are crucial to understanding the scene and patient's illness or injury.

4. Evaluate information in relation to context. Do this instead of maintaining the belief that information is context-free. In the ambiguity of an EMS scene, it's the context that gives information its value and meaning. Context-free evaluations, the belief that the information is true regardless of circumstances, leads people to rigidly following rules despite evidence that those rules aren't working. This has been described as "the strong but wrong rule."[6]

5. Be process oriented. Getting it right is a process. Don't be preoccupied with outcome. HROs focus on getting it right rather than doing it right. Realizing that a process precedes every outcome and every situation improves our judgment about the circumstances we encounter on scene.

Weick expanded Langer's concept of mindfulness from mindfulness in the individual to collective mindfulness. Collective mindfulness is shared across the team through interactive behaviors and awareness.[7] This requires open and aggressive communication, including both verbal and nonverbal cues, between all members involved—whether on scene or at a distance from the scene.

SENSEMAKING

Sensemaking is how we give meaning to the ambiguous stimuli we encounter on scene. Collective sensemaking refers to the common meaning obtained through shared references and framing of events. As anyone who trains novices can attest, sensemaking requires a common vocabulary and grammar beyond the technical terms we use. This is a selective vocabulary, and a rookie can become perplexed when describing a dynamic scene that's full of ambiguity and nuance. Sensemaking in emergencies in particular must be made without reference to past events or future trajectories, because we often don't have sufficient information to know where the events originated from or where they are going.

Sensemaking goes beyond alertness, which is an effort to notice things that are out of place. Instead, we refer to awareness, which is an effort to generate conjectures about the meaning of events. In emergencies, we tend to search for meaning, settle

on something plausible, and then move on.

During a transition from a public safety approach of decision making to a medical approach, you must accept the fact that, in the rapid moving environment of prehospital EMS, paramedics decide and physicians evaluate. This means paramedics would make a decision and move on with other tasks, which include reassessment, while doctors would evaluate and re-evaluate searching before they decide the correct diagnosis and treatment.

We tend to simplify sensemaking for easier analysis and decision making. Adrian Wolfberg, PhD, describes two analytic processes: puzzle-solving and mystery-solving.[9] With puzzle-solving, the analyst has faith that collecting sufficient data will fill the puzzle blanks and produce the answer. In a mindless state, as opposed to one of mindfulness, this produces the drive to fill in all the boxes on a form despite irrelevance or if it interferes with treatment. The goal is to collect as much information as possible with blind faith that an answer will emerge. It's consistent with deductive reasoning processes where facts guarantee the hypothesis. This can become a drive to collect more facts simply for security.

MYSTERY-SOLVING

Mystery-solving emphasizes the uncertainty of a situation, which comes more naturally to those working in the field environment. The uncertainty is from the complexity of human interactions on today's battlefield.[9]

For EMS, we add together the interactions between the patient and disease or injury along with human interactions on scene between bystanders and other public safety officers. Wolfberg describes this as full-spectrum analysis; that is, we analyze the full spectrum of events and the environment rather than discrete segments that fit our models.

The discrete concepts we use for sensemaking in dynamic situations simplify and lag behind the full-spectrum, continuous perceptions of our experience. Our grasp of events, then, becomes subject to misidentification and misunderstanding.[3]

EMS is a dynamic mystery, not a static puzzle. Decisions, once made, become possessions. Compared to decision-making, sensemaking is more adaptive to the ambiguity and dynamics of EMS. "If I make a decision it is a possession, I take pride in it. I tend to defend it and not to listen to those who question it. If I make sense, then this is more dynamic and I listen and I can change it. A decision is something you polish. Sensemaking is a direction for the next period."[3]

One of the first things rookies in EMS, fire and law enforcement or the military learn is to engage the situation, not to withdraw. For safety purposes one may, of course, withdraw to a safe location, but observation is a form of engagement; inaction is an active decision. This is described as enactment as a much deeper level than engagement, but this is necessary to understand how HROs work.[10]

SUMMARY

Enactment describes how we engage the situation to make sense of it. But by our engagement, we also change the situation. Our presence, alone, will change the situation. At times, we may fail to act. Here, we are at risk of interpreting this as a sense of personal "limitation" in what we can do. This will inhibit us in engaging in other incidents. Rather, we should understand that while we may often fail after engaging, acting is part of performing in uncertainty.

In EMS, the system, as it's set up, can lead people to fail to act. For reasons specific to a system, the EMT or medic may not act for fear of doing something wrong. This failure to act reinforces the limitations one feels. When you avoid acting, you don't learn. By avoiding testing ourselves, we conclude that constraints exist. This is contrary to the historical approach public safety and EMS personnel use to learn. In the past, it was accepted that we learn what works through action.

We also perceive, or sensemake, through interaction with the environment. We watch for responsiveness to our actions, such as cooperation from bystanders vs. defiance. However, this is influenced by how we approach the scene. One EMS provider may obtain cooperation while another experiences defiance. We bracket this information by placing it in context. This interaction is difficult to communicate to those not present at the incident, because they don't know when one "story" begins and when another leaves off.

HROs have developed in organizations that adapted to time constraints in uncertain and hazardous environments. There, lessons were actually learned through the blood of live-or-die situations. Academics have codified these principles and concepts that are accessible to EMS caregivers. EMS can benefit from the principles and concepts of HRO through improved performance by individuals and stronger organizations.

The authors would like to acknowledge the work of Ron Stewart, MD, who, in the 1970s, combined the principles of ambulance work and firefighting with medical care; Jim Page, JD, who encouraged the application of HRO principles as developed from 1970s EMS into today's EMS; and Karl Weick, PhD, for bringing science to applied HRO and reviewing our manuscript. **JEMS**

Daved van Stralen, MD, FAAP, is a consultant with Strategic Reliability LLC; medical director for American Medical Response in San Bernardino County; and a physician with the Loma Linda University School of Medicine Department of Pediatrics. He can be reached at vanstralen@stratrel.com.

Thomas A. Mercer, RAdm, USN (retired), is a consultant with Strategic Reliability LLC. He flew 255 Vietnam combat missions; his awards include the Defense Distinguished Service Medal, the Distinguished Service Medal (two awards), Legion of Merit (two awards) and Distinguished Flying Cross (three awards).

REFERENCES

1. Perrow C: *Normal accidents: Living with high risk technologies.* Basic Books: New York, 1984.
2. Rochlin GI, La Porte TR, Roberts KH. The self-designing high-reliability organization: Aircraft carrier flight operations at sea. *Naval War College Review.* 1987;76–90.
3. Weick K. Organizing for transient reliability: The production of dynamic non-events. *Journal of Contingencies and Crisis Management*. 2011;19(1):21–27.
4. Weick K, Sutcliffe K. *Managing the Unexpected: Resilient Performance in an Age of Uncertainty, 2nd ed.* Jossey-Bass. San Francisco, 2007.
5. Langer E. *Mindfulness.* Da Capo Press: Cambridge, Mass.: 1989.
6. Reason J. *Human Error.* Cambridge University Press: Cambridge, UK, 75–76, 1990.
7. Weick K, Roberts K. Collective mind in organizations: Heedful interrelating on flight decks. *Administrative Science Quarterly.* 1993;38(3):357–381.
8. Weick K. "Reflections on enacted sensemaking in the Bhopal disaster." *Journal of Management Studies.* 2010;47(3):537–550.
9. Wolfberg A. (July–August, 2006). Full-spectrum analysis: A new way of thinking for a new world." In *Military Review.* Retrieved from http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview_20060831_art008.pdf.
10. Weick K. "Enactment and organizing." In *The Social Psychology of Organizing, 2nd Ed.* McGraw Hill, Inc.: New York:147–169, 1979.