Effective Utilization of the Incident Command System in a High-Reliability Environment

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ABSTRACT

The incident command system (ICS) is a standardized method of managing emergency incidents caused by fires, accidents, hazardous materials, and other natural or human-caused disasters. ICS is a flexible system that consists of established procedures for managing resources such as personnel, equipment, and communications. This study includes the examination of a suburban volunteer fire department's use of ICS at all incidents. The utilization of interdisciplinary training methods, post-incident assessment techniques, and formation of strategic alliances are identified as the primary components that contribute to the effective management of an incident.

1. Introduction

The incident command system (ICS) is a standardized method of managing emergency incidents caused by fires, accidents, hazardous materials, and other natural or human-caused disasters. This flexible system consists of established procedures for managing resources such as personnel, equipment, and communications. Although bureaucratic in form, the ICS framework can be effectively expanded or contracted to meet the needs of managing routine incidents such as minor traffic accidents to major catastrophes that may involve many agencies. The ICS provides a basic template for organization with the critical functions defined and it then outlines numerous flexible ways in which to organize the operational and staff components (Banner, 2004). Weber's (1947) description of a bureaucracy as being an efficient, ongoing, self-regulating organization of experts all focused on achieving a specific goal is an adequate description of today's fire service organizations (Caulfield, 1985).

This study entails the examination of a suburban volunteer fire department's use of ICS at all incidents. The utilization of interdisciplinary training methods, post-incident assessment techniques, and formation of strategic alliances are identified as the primary components that contribute to the effective management of an incident. Other underlying factors such as structuring mechanisms, organizational support for constrained improvisation, and cognition management methods have also been identified as contributing agents that lead to exceptional organizational reliability under volatile environmental conditions (Bigley & Roberts, 2001). The ICS was developed as a consequence of fires that consumed large portions of wildlands in California in the early 1970's. The ICS is recognized by the National Fire Academy as a system that is documented and has been successfully used in managing available resources at emergency operations (National Fire Academy, 1987). The Occupational Safety and Health Administration (OSHA) requires all government and private organizations that may handle hazardous materials to use ICS. The Environmental Protection Agency (EPA) rules require agencies located in non-OSHA states to use ICS at hazardous materials incidents (NYS Emergency Management Office, 2003). ICS is now accepted as the standard management system that is used by approximately 30,000 fire departments throughout the US. The proper design and use of an ICS enables a manager to effectively synchronize the resources of different agencies, rapidly deploy these resources,revise tactics to meet changing incident conditions, and clearly communicate instructions to personnel.

2. Literature Review

Although research has been conducted on the management and decision-making processes of high-reliability organizations (Weick & Sutcliffe, 2003; Klein, Bigley & Roberts, 1995), very little attention outside of industry-specific trade journals has been paid to the training and assessment methods used by these

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organizations. Bennett (2011) states that those involved with managing an emergency response incident do not always have the time to thoroughly analyze the situation and eliminate all risk before acting. This underscores the need for managers of high-reliability organizations to develop a standardized yet flexible system to manage incidents in a turbulent environment.The successful management of an event is predicated on the training that occurs before the actual incident and the assessment following the incident.Hwang (2003) proposes that training strategies should encourage knowledge transfer and the reflection process, while Roberts, Bea & Bartles (2001) suggest that managers of high-reliability organizations aggressively seek to know what they do not know and communicate the big picture to everyone.

The literature on high-reliability organizations dates back several decades. Roberts (1990) defines high-reliability organizations as entities that are required to achieve a record of high safety over a continued period of time. Weick (1987) suggests that a high-reliability culture breeds a value system that provides incentives for failure detection. More recently, Prager (2013) refers to high-reliability organizations as systems that operate in complex and hazardous conditions with a goal of achieving nearly error-free performance. The common theme among these organizations, whether they are engaged in public safety, healthcare, or national defense, is the need to achieve consistent results in a turbulent and often dangerous environment.

To succeed in a high-reliability environment, organizations must be prepared to adapt to advancements in technology and management practices.Vogus and Welbourne (2003) suggest that reliability-seeking entities organize to remain receptive to emerging information and innovative concepts. Bigley and Roberts (2001) assert that reliability, the capacity to continuously and effectively manage working conditions, is vital to organizational quality and competency. Whereas, Offstein et al (2013) find that high-reliability organizations must continuously strive toward improved operational safety and performance. Although the need to manage change also exists in the business and financial sectors, the consequences for a high-reliability organization's failure to adapt can lead to the direct loss of life and property.

2.1 Structural Components of ICS: C-FLOP

The origins of the incident command system can be traced to many of the general principles of management put forth by Fayol (1916). At the core of an ICS are principles such as unity of command, unity of direction, discipline, and initiative. ICS should be viewed as a method that is flexible enough to be utilized at every incident, rather than a structure that is initially developed and never refined. This standardized system is designed to effectively coordinate the skills of men and women from different agencies and jurisdictions to operate as a cohesive unit without any loss of authority, responsibility, or accountability. Although the objectives and strategic plans are developed at the command level, subordinates are given latitude to improvise and revise tactical procedures. Brown and Eisenhardt (1997) used the term "semistructure" to describe the management practice of prescribing certain specific procedures of a project, yet leaving other aspects unspecified. To illustrate, a fire crew may be instructed to utilize a direct attack on the fire by entering the burning structure and applying water. Upon entering the structure, the crew leader determines that hazardous chemicals are located in the structure. He then instructs the team to evacuate the structure immediately and notifies command of the newly found facts.

The ICS framework consists of five components referred to as C-FLOP. These components are command, finance, logistics, operations, and planning (see Figure 1). At every incident, there is only one incident commander. He is responsible for the overall management of the incident including establishing strategic goals and allocating the resources. It is quite common for the incident commander to transfer command to another officer during the incident. For example, a department captain may be the first officer to arrive at the scene. After conducting a size-up of the scene and developing an initial strategy, the department's chief may arrive. The captain will then inform the chief about details of the incident and relinquish command. The captain may then be assigned to another role at the fire scene. Other reasons for transferring command may be due to the extended time-span of the incident or a legal or jurisdictional requirement to shift command to another department or agency.

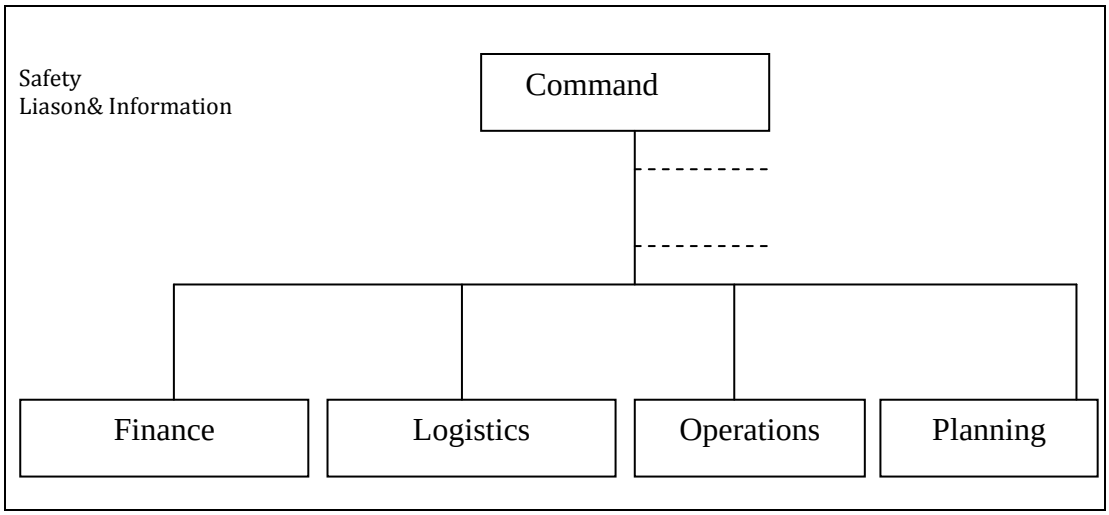

Figure 1: Incident Command System (C-FLOP)

The finance function includes the procurement of resources from outside agencies and the documentation of these costs. The logistics function provides support services to personnel such as food and temporary lodging during extended incidents. Planning is a continuous function that includes the preparation of timely reports about the progress of the incident and status of the available resources. At many incidents that are smaller in scale, these three functions may be conducted simultaneously by one officer.

The operations officer is responsible for developing the tactical procedures to carry out the incident goals. At a complex incident such as a multiple unit dwelling structure fire that involves victims trapped in the building as well as reports of hazardous materials, the tactics deployed may mean the difference between life and death. The optimum span of control for any officer is usually between one to five subordinates. Groups are assigned specific functional tasks such as search, ventilation, fire suppression, and staging. Divisions may be formed according to geographical location. For example, the search group may be further departmentalized into several divisions, with each division being responsible for a specific sector of the building.

3. Illustration: A Department's use of ICS Used at the Fire Scene

The fire department observed in this study is a volunteer force consisting of 35 men who serve a single town in a densely populated area of northeastern United States. The town consists of approximately 4,500 homes and also houses a volunteer emergency medical service (EMS) department and a paid police department. The fire department is responsible for the operation and maintenance of two fire engine pumpers, a ladder truck, and a rescue vehicle. Each of the department's members is trained to operate all of the tools and equipment located on all of the 4 fire apparatus. This is in contrast to many other larger fire departments throughout the country that are departmentalized into functional units such as ladder, engine, and rescue companies. The line officers consist of a chief, assistant chief, captain, and 4 lieutenants. The department responds to approximately 350 calls per year. These calls include structure fires, automobile accidents, and hazardous materials incidents.

The following incident illustrated here occurred on a weekday afternoon. It began when the central dispatching agency received a call from a resident stating that there was smoke and a fire in her kitchen. After instructing the occupant to vacate the premises, the emergency dispatch operator transmitted an alarm page to the fire and police departments. A police unit with two officers was first to respond to the scene. One officer escorted the resident away from the building and she notified him that there were no other people in the dwelling. From a viewpoint outside of the building, the second police officer noticed that there was heavy smoke coming from the kitchen. At that moment, the fire chief arrived on the scene in the chief's vehicle and established command by sending a radio message to the central dispatch station. After being briefed by the two police officers and the occupant of the building, the fire chief conducted an initial size-up of the scene and determined there was an oven fire in the kitchen.

The department's standard operating procedure is for firefighters to report directly to fire headquarters for all calls. Each reporting member dons their protective gear and breathing apparatus, and reports to the vehicle designated as first-due. This vehicle designation is based on the nature of the incident and is part of the department's pre-established standard operating procedures. For accountability purposes, each firefighter must then place his ID tag on a board located inside the fire apparatus. As soon as the first crew consisting of an officer, driver, and at least two firefighters are formed, they proceed to the scene and notify central dispatching that they are en route.

As the crew proceeded to the scene, the chief communicated to the crew's officer the nature of the incident, the exact location to stage the engine, and the specific location of the fire hydrant to use for water supply. When the engine crew arrived at the scene, the chief and crew officer discussed the different possible tactical maneuvers available to suppress the fire. Since no victims were involved in this incident, the chief and officer's primary criteria for basing their tactical operations were firefighter safety and preservation of property. After assigning the police officers to traffic control, the fire officer then instructed two of the firefighters to proceed with the attack hose line from the side entrance of the house. The third firefighter had already been deployed to connect the engine's five-inch hose to the fire hydrant. The driver then assumed the role of the engine's pump operator. After quickly suppressing the fire, the two firefighters on the attack line were instructed by the officer to turn off the main gas line to the house.

The fire chief then designated the crew of the second arriving apparatus, the ladder truck, to stand by as a backup unit. He notified the third crew to remain at fire headquarters. The chief then instructed both available crews to proceed with the salvage phase of the operation. This involved ventilating the smoke with an electric ejector and removing any water from the house. The fire chief and officer then conducted a final walk-through of the house and determined that it was safe for the occupant to return. The amount of time that elapsed from the resident's initial call to the suppression of the fire was only twelve minutes. Immediately after being returned back to the fire headquarters, the apparatus was restored to service. All tools that were used were sharpened, lubricated, and inspected. All hose lines were repacked and all breathing packs were replenished with air. After assigning the fire officer to complete all required documentation about the incident, the fire chief then debriefed the firefighters and assessed the overall incident operation.

The description of this incident illustrated how the five components (C-FLOP) of the incident command system could be effectively established and employed. In this particular case, the fire chief and officer were able to utilize ICS to effectively manage the operation. Even though this incident would not be considered too complex, a closer look may reveal exactly how well the ICS served. In the confined space of the incident, there were a total of four emergency vehicles, eleven firefighters, two police officers, and two different agencies working together in a volatile environment to achieve one common task. If the chief had arrived on the scene and found multiple buildings fully engulfed with fire, he could have expanded the ICS rapidly to meet the needs of the incident. With a single radio call to the central dispatching agency, he could notify neighboring towns for the need for additional manpower and equipment as well as other agencies to deal with hazardous materials, medical treatment, environment protection. To reduce his span of control, officers could be appointed to manage the various functions of the ICS. The operations function could be further broken down into search & rescue, fire suppression, and ventilation units each with its own officer to increase the manageability of these tasks.

4. ICS: How and Why It Works

The incident command system has a number of underlying components that work together interactively to form an effective system of management. These components consist of a unified command structure with consolidated action plans, common terminology with integrated communications, modular organization to rapidly expand or contract, manageable span of control for officers, pre-established standard operating procedures, and pre-designated incident command facilities (Hunt, Carter, & Kelly, 1993). As an incident expands from an operation that involves a single agency to one involving multiple agencies and jurisdictions, the complexity of managing this incident will increase exponentially. To identify the primary factors that contribute to the success of an ICS, it is first helpful to examine the factors that lead to an unsuccessful system of management. Command dysfunction, a systemic failure in the incident management system, can be attributable to any combination of the following six factors: lack of risk assessment, lack of

responder discipline, misuse of the incident management system, lack of effective incident commanders, lack of accountability, and lack of effective communications (Daniels, 2002). Interdisciplinary training methods, assessment techniques, and alliance formations are identified as three key factors utilized to mitigate the causes of command dysfunction (see Figure 2).

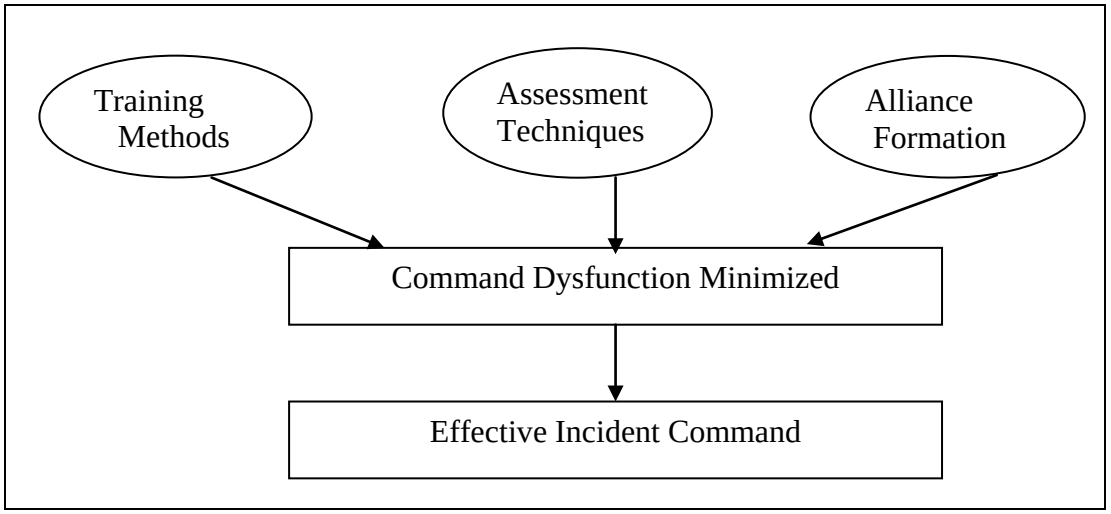

Figure 2: Effective Incident Command: Factors

4.1 Interdisciplinary Training Methods

It is a mandatory requirement for each member of the fire department depicted in this study to complete a course administered by the county's fire academy. The pedagogical approach utilized by qualified instructors in this course consists of classroom lectures, video presentations, and hands-on demonstrations of tasks. Each candidate is required to pass written examinations and demonstrate a level of competency in performing various firematic tasks. A detailed study of the use of the incident command system on the fire scene is covered in this course. Thisfoundation course serves to provide firefighters with a broad range of basic skills and a general understanding of ICS. All members are then encouraged to take advanced level courses to increase their firefighting and management skills.

In addition to this initial training, members of the fire department observed in this study are required to participate in mandatory weekly drills. The assistant chief, who also serves as the training officer, schedules the specific content to be covered in each drill. For each drill, firefighters are assigned into teams that usually consist of approximately five members with varying levels of experience. Each team is assigned a specific task and all team members are required to actively participate in the decision making process to develop tactics to complete the task. Team members with less experience are encouraged to formulate a plan that consists of tactics to complete the task. More experienced team members will then give immediate feedback on these proposed plans. After a task is completed, the team will rotate to the next task assigned. This training approach allows for more resources from which to draw when faced with increasingly complex decisions and also supports an integrated and cooperative business environment (Kaplan & Welker, 2004). Drew and Coulson-Thomas (1996) suggest that the utilization of cross-functional teams will lead to the breaking down of boundaries to effective communication and collaboration that will lead to organizational adaptability and flexibility.

Innovation can be in the form of new ideas,methods, and products (ICMA, 1979). A challenge faced by managers of high-reliability organizations is to reduce the resistance to change by personnel (Binci & Cerruti & Donnarumma, 2012). To address this issue, the officers of the fire department observed in this study foster an innovative environment by encouraging all members to introduce new products and concepts into the department. Firefighters in this department are exposed to innovative products and methods by attending conferences, reading trade journals, and participating in joint training drills with other fire departments. All new products are thoroughly tested during training drills before being placed into service. Each department member is required to physically operate the new tool and read all instruction manuals that accompany this tool or piece of equipment. All feedback about the performance

and applicability of these new products is encouraged not only during the training period, but also after each use at an actual incident.

Perhaps the most important aspect of a firefighter's training is the emphasis that is placed on his ability to remain collected and focused at an incident. It seems paradoxical by nature for a firefighter to be trained to pay attention to details, yet be encouraged to try to see the big picture. Bennet (2011) concludes that first responders often do not have enough time to fully analyze and plan a dynamic event. To address this challenge, a key element that is accented in all phases of training is the firefighter's ability to be prepared. To illustrate, it is not unusual for a volunteer firefighter to place his clothes at the side of his bed before going to sleep in order to facilitate a quick response to the firehouse in the event of a late night call. A central theme of many training drills is to expose firefighters to the different ways that a relatively routine event can instantaneously develop into an extremely dangerous incident. For example, firefighters can view a training video that depicts how a small brush fire can rapidly spread with a shift in the wind patterns. Primarily because of repetitive training drills, firefighters develop the idiosyncrasy of being able to "expect the unexpected". Although the ability to utilize available tools and equipment proficiently and to develop a level of comfort and confidence during their use is essential to all firefighters, the ability to respond to a rapidly changing condition in a turbulent environment remains the cornerstone of training objectives.

4.2 Post-Incident Assessment of Operations

Because of the unique nature of an emergency event, it may be extremely difficult to evaluate how successful an incident was actually managed. Unlike a business project or venture that may be measured in terms of net income or cash flows, an emergency incident does not yield data that can readily determine the performance of those managing the incident. The primary objective of assessing and critiquing the decisions made on the fire grounds is to increase the management effectiveness of future incidents. March and Simon (1958) suggested that an organization can develop a performance program that establishes a highly complex set of organized responses to meet recurrent decision situations. Cyert and March (1963) later suggested the use of specific operating procedures that are designed to lead to preferred outcomes. Because of the extreme consequences that may result from decisions made by emergency service personnel, an emphasis is placed on management effectiveness rather than efficiency. To illustrate, an incident commander may arrive at a scene and find a large amount of smoke coming from a building. He may immediately summons personnel and apparatus from three other neighboring towns to the scene. Even if it turned out to be just a small trash fire that a single engine crew could have easily extinguished, the incident commander's action was warranted because waiting to activate additional resources could result in the loss of lives or extensive property damage. A good incident commander must be able to use his prior experiences to facilitate the decision making process without being handcuffed by prior decisions that did not turn out to be optimal.

To assess how successful an emergency incident has been managed, the incident should be evaluated based on absolute incident success and incident management success. Absolute incident success identifies the final outcome of the event in terms of fatalities, injuries, and property loss. Equipment damaged and resources used at the particular scene are also quantified. Incident management success places an emphasis on the evaluation of tactics utilized, the coordination of different departments and agencies, and the adherence to pre-established standard operating procedures by officers and firefighters. Although the statistics pertaining to absolute incident success may receive more attention when evaluating the outcome of an incident, this data should take a back seat to the qualitative data yielded by incident management success. Latent errors, defined by Ramanujan and Goodman (2003) as uncorrected deviations from procedures and policies that potentially can contribute to adverse organizational consequences, could be mitigated by the effective focus on incident management success after every incident.

It is a standard procedure for the fire department observed in this study to conduct an assessment session immediately following all incidents and training drills. This session, lead by officers, serves as a forum for all firefighters to give and receive feedback from the incident or drill. The tone of this forum is very constructive, rather than critical or judgmental. It is not uncommon for the incident commander to open the meeting by discussing an operating tactic that he employed that did not work. For example, the officer may discuss how he positioned the first-due engine too close to the burning structure and that the shift in wind direction caused the need to re-deploy the engine. Because of the constructive environment set by the officers at this meeting, firefighters are very open to contribute candid information about their experiences during the incident. To illustrate, a firefighter may discuss how he chose the incorrect tool to complete a

task and how this caused a delay. Rather than responding with harsh criticism, the officers may use this information to determine whether the tools should be rearranged on the apparatus to a more easily accessible location.

4.3 Formation of Strategic Alliances

Strategic alliances can be utilized to effectively diffuse new technologiesand quickly learn from leading organizations in a given field (Elmuti & Kathawala, 2001). Many fire departments enter into alliances with other departments because they lack essential resources that may not be practical to acquire because of their infrequence of use.The need for many fire departments to gain access to resources of other organizations is apparent. Areport by Hall, Karter, and Whitney (2002) revealed that only 11% of the fire departments can handle a structural collapse of a building with 50 or more occupants. This study also revealed that only 13% of the nation's fire departments could handle a hazardous materials incident involving 10 or more injuries.

Strategic interdependence between organizations describes a situation in which one organization has resources or capabilities beneficial to but not possessed by the other (Gulati, 1995). In addition to gaining access to the use of durable equipment, fire departments may enter into alliances with neighboring towns to decrease response times for large-scale incidents. Exposure to technological advances and access to competency skills possessed by officers of other fire departments are also advantages of entering into alliances. Ciborra and Andreu (2001) point out that in a successful alliance it is likely that the learning ladders of the partners will intertwine like a DNA double helix: in this way knowledge becomes shared across separate organizations and new knowledge is developed in the process. Although Barney (1991) suggests that resource heterogeneity leads to an advantage only when the resources are valuable, rare, and durable; more recent studies argue that competencies themselves, although intangible, may be considered a resource (Hamel & Prahalad, 1994; Hunt, 1997; Lambe & Spekman, 1997).

The fire department observed in this study participates in two different mutual aid associations that consist of approximately thirty other neighboring paid and volunteer fire departments. These mutual aid associations serve to nurture an environment of cooperation and teamwork among its affiliated members. This is in sharp contrast to the reported fierce rivalries that occurred between neighboring fire departments during the 19th century. The department relies on other members of the association to provide machinery and manpower such as a heavy operations rescue team. In return, the department contributes its resources when called upon. Alliances with other agencies such as EMT, police, hazardous materials unit, and central dispatching agency all contribute to the adaptability and effectiveness of the department's operating capacity.

5. Conclusion and Further Implications

The standardized use of ICS as the system for managing resources at an emergency incident has served to minimize the elements identified as the causes of command dysfunction. ICS should not be viewed as a fixed set of principles that are rigid and unchanging in nature. ICS concepts will evolve as more information about the emergency services field becomes available. New technologies as well as different types of incidents that may emerge in the future will also contribute to the evolution of ICS concepts.

As with most case studies, there are inherent limitations in this report. The primary focus was on a single fire department located in the northeast section of the US. This department does not respond to incidents such as wildfires and aquatic rescues that may be more common in other locations throughout the country. The firefighters from this department are all volunteers with various levels of experience and training. A future study of a paid fire department could identify additional underlying factors that lead to the successful utilization of the ICS.

A future research opportunity may be available to extrapolate the findings from this report to the business sector. High-reliability industries such as the health-care and utility sectors could possibly benefit by incorporating components of ICS into their management philosophy. Other fields, such as the financial services and auditing industries could also find reap a benefit by utilizing the ICS management approach.

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