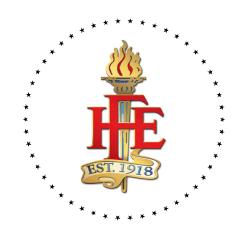# Crew Resource Management for Improved Command, Control, and Firefighter Safety

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Crew Resources Management for Improved Command, Control, and Firefighter Safety

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Over the past 25 years that the National Fire Protection Association has been keeping data on fire fighter injuries and deaths in the line of duty, we have seen a reduction of almost 50% of that yearly toll. While looking at the bare numbers it would appear that we have made significant progress in our efforts to improve fire fighter safety, the NFPA just this year points out that in that same time period structural fires have also declined by more than 50% and that the death rate for fire fighters while engaged in interior structural fire fighting is actually on the increase.

It is unfortunate that in this day and time we continue to experience a relatively large number of fire fighter fatalities that can be prevented. Over the past 25 years, we have fairly consistently experienced approximately 100 fire fighter fatalities per year, during a time when we have seen a significant drop in fires nationally. Efforts to reduce fire fighter fatalities since the early 1980's have dealt with improving technology such as personal protective equipment, SCBA, pass devices, and incident management practices among others. While these prior actions have, no doubt, been somewhat successful, fire fighter fatalities have reached a plateau and leveled off from the levels seen in the late 1970's and 1980's. If the fire service is to be successful in continuing to lower the tragic and unnecessary continued loss of life, we will have to continue to take a look at how we do our business and be prepared to make some hard, but necessary, changes.

Other industry operations with complex and dangerous work environments have experienced similar challenges to safety in the past. Perhaps it is time for the fire service to learn not only from our own experience, but also look at other sources for solutions to the safety challenges we face today and that may get even worse in the future. One of the industries that have made significant improvements in safety over the past 25 years is the

Aviation industry, and specifically the major air carriers in the United States. The program developed by the airlines is called Crew Resource Management (CRM). Over the past few years, more and more interest has developed in the fire service to adapt this concept to improve our command, control, and communications capability and as a result improve the safety to our fire fighters.

Crew Resource Management, which has been used by the aviation community very successfully for more than a decade to reduce aviation accidents and the resulting crash fatalities. The majority of the interest for CRM in the fire service is an outgrowth of a cooperative effort of the International Association of Fire Chiefs, the International Association of Fire Fighters, the commercial airline industry, the US Air Force, the US Coast Guard and others. The same concept has also been shown to be effective in the nuclear power industry and the offshore oil and gas industry. The common denominator with all these diverse operations and activities, and in the fire service, is that fireground operations are complex, sequential, and are required to be conducted in a compressed timeframe if they are to be effective.

The fire service is only now beginning to realize that the root cause(s) of many fire fighter fatality incidents is not equipment or technology failure, but the result of various human factors coupled with the decision-making process that everyone engages in at the scene of an emergency incident. More and more evidence is being identified and acknowledged that many of the fire fighter fatalities that we continue to experience are the result of not following procedures, or following procedures which have been developed without knowledge of basic human factors.

Fireground practices are the backbone of safe emergency operations, providing guidance to the incident commander, company officers and members, and insuring a logical, efficient, safe, and predictable means of carrying out emergency scene objectives. Yet in emergency scene operations where procedures are inconsistent or illogical, fire crews may fail to follow procedures and a rising risk of serious injury will result.

These problems may have serious consequences: a number of studies of past fire fighter fatality incidents have shown that procedural deviations are, by far, the leading cause of crew or crew member caused accidents. This has shown to be consistent with the experience of other complex industry operations in aviation, maritime, oil and gas, and nuclear industry operations. Until recently, operating procedures, in general, have largely escaped the scrutiny of human factors researchers. While the fire service has seen virtually no formal study, there are studies, specifically in aviation, which appear to have application to a fire service environment.

In the late 1980's NASA undertook a broad study of airline cockpit procedure use and design. The study's results and conclusions were drawn from numerous observations of flight crews in the performance of their duties, extensive interviews with airline management representatives and pilots at three major airlines, interviews with major airframe manufacturers, and examination of National Transportation Safety Board accident reports and Aviation Safety Reporting System (ASRS) incident reports involving deviations from aviation standard operating procedures (SOP's).

The Four P's. The NASA study identified a development process called "The Four P's": Philosophy, Policies, Procedures, and Practices. If an organization commits to the Four-P model, it creates a set of procedures with greater compatibility, consistency, and compliance. What's more, there will still be room for individual techniques, as no set of procedures can substitute for the intelligent fire fighter. The concept principles of "The Four P's" are rewritten below in a fire service context.

Philosophy. A philosophy of operations is a fire service organization's overall view of how it will conduct business, including emergency scene operations. Philosophy is influenced by the organization's top decision makers and also by its organization (or fire service) "culture." For example, Plano's fireground procedures grant the first arriving officer the ability to establish command and retain command throughout the entire incident unless he/she formally "passes command" to another arriving company. In many

other fire service organizations a higher-ranking individual automatically assumes command upon arrival at the scene.

Policies. Policies broadly specify the manner in which management expects things to be done (training, station or apparatus maintenance, exercise of authority, personal conduct, etc.).

Procedures. Procedures specify what the task is, when it is to be conducted, by whom it is to be conducted, how it is done (actions), what the sequence of actions are, and what type of feedback or reporting is required. Procedures should be designed to be as consistent with policies as possible, which in turn should be consistent with philosophy.

Practices. Practices include every activity conducted at an emergency scene - correct execution of a procedure, the use of a technique, or any other action. Management specifies procedures, while fire officers and fire fighters conduct practices. Acceptable practices are usually identified in training manuals and training references developed for industry wide application. Ideally, procedures and practices should be the same.

The question and issue facing the fire service, specifically as it relates to our experience with a significant number of serious injury and fatality incidents, is: Why do well-trained and well-motivated fire fighters deviate from standard operating procedures and get seriously injured or killed in the line of duty?

Over the next few years we will hear more and more about the subject of "human factors" in the fire service as we strive to absolutely minimize the losses to our fellow fire fighters. The fire service is awakening to a wealth of new, never before considered information that will make the job of fire suppression safer and help reduce and minimize the needless loss of fire fighters lives.

Fire fighting has been long recognized as a dangerous, complex, high-risk occupation. It has been only in the past 25 years, however, that any quantitative data have been collected to clearly identify the scope and nature of the issue of fire fighter health and safety and to define the specific risk factors that can and should be controlled in order to minimize the impact on our nation's fire fighters. More and more today, every fire service organization in the United States is recognizing their duty and primary responsibility to protect it's work force from the direct and indirect effects of the hazardous environment that fire fighters are oftentimes required to work in and around. Efforts to improve fire fighter safety during the past 25 years have almost exclusively dealt with improving 1) personal protective clothing and equipment (PPE), and 2) control of operations -- Incident Command System, Standard Operating Procedures, etc. What has not been widely recognized, however, is the human factors and underlying unrecognized causes of accidents/incidents that result in serious fire fighter injuries and fatalities. Research on health and safety, and more specifically human factors of safety has identified a concept called the "error chain", which one may apply to recognize the human aspects of fireground safety in the hope of taking the next leap forward in improving fire fighter health and safety.

The error chain is a concept that describes human error induced accidents that occur as the result of a sequence of events that eventually culminates in the death(s) or serious injury (ies) to a fire fighter or a crew of fire fighters. In these situations, there is seldom a single overpowering cause. Typically, there is a number of contributing factors and errors present, thus the use of the term "error chain". The links of these error chains are identifiable by means of 12 "clues" divided into both operational and human behavioral factors. Recognizing and breaking any one link in the chain increases the potential to break the entire error chain and prevent a resulting incident where fire fighter injuries or fatalities are likely to result.

More than 50 fireground incidents where fire fighter fatalities or serious injuries have occurred have been examined in developing and testing the concept of the "error chain".

Each was examined from the perspective of: "if this fire crew had been trained to recognize links in error chains and been proficient in doing so, were there links present which, if found (identified or recognized), would increase the probability and likelihood that it would have caused a different crew response and eventual outcome (avoided the fatality or serious injury)?"

In most of the events considered, the answer was "yes". The fewest links discovered in any one accident was four; the average was seven. Yet, recognizing and responding to only one link is all that is usually necessary to change an outcome. The presence of more than one link serves to enhance the potential for a timely recognition of an error chain.

While an error chain might be relatively easy to reconstruct during an accident investigation, the presence of one may be difficult for a fire fighter or fire crew to detect as it occurs. Familiarizing fire fighters with the concept of the "error chain" can correct this.

There are at least 12 clues to identifying links in an error chain. They are divided into operational factors and human behavior factors. The presence of any one, or more, does not mean that an accident will occur. Rather, it indicates rising risk in fire service operations and that fire fighters and fire officers must maintain control through proper management of both risk and resources.

OPERATIONAL FACTORS

1. **Failure to Meet Benchmarks or Targets in a Timely Manner**

    Failure of the fireground personnel to attain or maintain identified benchmarks, targets, or objectives of the overall strategy employed at an incident. This includes operational tactics, procedures, or any other goals established by the incident commander or fire fighting resources (fire crews).

EXAMPLE: Fire attack has been underway for at least 10 minutes with no discernable reduction in fire volume or change in tactics. Command may or may not recognize that a change in tactics is necessary or desirable, but when Command does, the radio exchange goes something like this: "Command to interior – back your lines out of the structure, we are going defensive." "Interior to Command, we almost got it, all we need is 30 more seconds Chief, and we'll have it knocked down."

This is a losing situation. Interior crews are usually not going to be able to make headway on the fire if their attack has not been successful in the first few minutes. It's better to be out of the structure five minutes early, rather than five seconds too late.

2. **Use of an Undocumented/Unauthorized Procedure**

This involves use of a procedure or procedures that is not prescribed in approved training manuals or operational safe practices to deal with abnormal or infrequent conditions.

EXAMPLE: Applying master stream into an occupied structure; placing attack line in roof ventilation hole, etc., or attacking the fire from above the seat of the fire (Seattle and Washington, DC fatality incidents).

3. **Departure from Standard Operating Procedures (SOP's)**

The intentional or inadvertent departure from prescribed standard operating procedure creates a situation of rapidly increased risk of serious injury or fatality. Well-defined SOP's are the result of a synergistic approach to problem solving with the influence of time removed. As a result, in different situations Standard Operating Procedures

represent an effective means of problem resolution without the sacrifice of time, which is often not available.

I am not suggesting that SOP's will resolve all problems. However, following established procedures will typically facilitate safe and effective operations. Failure to follow SOP's constitutes a link in the error chain and is an appropriate indicator of rising risk.

4. <u>Violating Limitations</u>

his factor involves the violation of defined operating limitations or specifications either intentionally or inadvertently (unintentional), as prescribed by regulations, manuals, or specifications. This includes equipment specifications, operation limitations, or local, state, or federal regulations.

Example: Operating an aerial ladder at low angles; overloading the ladder at full extension; operating an aerial ladder without ground jacks.

5. <u>No One in Command and/or Free Lancing</u>

No one establishing and monitoring progress of an incident action plan and the progress of the operation against the plan, or individuals or crews operating independently (outside) of the command structure. Control of the fireground is the highest priority for operational personnel. If command of the situation is not being attended to, then perhaps other important tasks are being overlooked as well. The only thing worse than no plan on the fireground, is two or more plans.

6. No One Aware of the Overall Operating Environment

Often referred to as "tunnel vision", it is easy to lose sight of changing conditions. The lack of a careful eye above, around, outside, or being aware of what is going on at all times leads to a lack of situational awareness and rising risk. This situation is typically demonstrated where operating sectors are not providing continuous updates to Command on the progress, or lack of progress, being made in achieving the goals of the incident action plan.

Human behavior factors frequently contribute to fire fighter fatalities. Human error plays a significant part of our day-to-day lives. These factors are not unique to fire fighting. These factors are common to many of the problems we experience as humans. Most of the time the consequences of these problems are not fatal, but in fire suppression, they may lead to serious consequences.

7. Incomplete Communication/Information

Incomplete communication or information is the result of unknown or non-communicated information, events, conditions, situations or questions about the incident, and failure to seek resolution of this confusion or disagreement. For example, if one fire crewmember withholds observations or knowledge of existing hazards or fails to question another fire crewmember about an area of concern, a link in the error chain exists. We also know that full and complete information on the fire ground is oftentimes unavailable or difficult to come by, at best. A very conservative approach should be undertaken to make sure that the risk that is being encountered does not overshadow the benefits to be derived by the operations being used.

8. **Ambiguity**

Ambiguity exists any time two or more independent sources of information do not agree. This can include observations, radio reports, and people, training manuals, SOP's, senses or expectations that do not correspond with existing conditions being observed at the time. Everyone should also be fully aware that the safety of all personnel at the fire scene is dependent on all critical information being shared by everyone.

9. **Unresolved Discrepancies**

Unresolved discrepancies is the failure to resolve conflicts of opinion, information, or changes in conditions, or not raising issues that need to be brought to the attention of command or sector officers. Discrepancies that are observed or changes in the conditions being encountered must be communicated to Command for resolution.

10. **Preoccupation or Distraction**

Preoccupation or distraction is the focus of attention on any one item or event to the exclusion of all others. This may include any number of distractions that can draw attention away from the progress of the operation. Distractions can be the result of stressful operating conditions, high workload, malfunctioning equipment, or just the deteriorating conditions found at most fire situations. Distraction may also be the result of personal problems, inattention, complacency, or fatigue, which may be experienced by any one or several persons who are operating at an incident scene.

11. **Confusion or Empty Feeling**

Confusion or an empty "gut" feeling is a sense of uncertainty, anxiety, or bafflement about a particular situation. It may be the result of mentally falling behind the pace of

operations or a lack of knowledge or experience. Perhaps it is caused by being pushed to the limits of one's training or operational ability or such psychological symptoms and effects as a throbbing temple, headache, stomach discomfort, "gut feeling", or nervous habit. Human factors researchers suggest that these signals are symptomatic of uneasiness and should be treated as indicators that all may not be right. If it doesn't feel right – **Get out!**

12.   **Belief of Invulnerability**

Perhaps the most dangerous of human factors is the one of feeling that, "I won't get hurt, that only happens to others". Whether willed into complacency by "years of experience" of running into burning buildings or driven by the psychological effects and adrenaline rush of the operation, this factor is oftentimes the foundation and precursor to additional links that increase the risk and probability or likelihood of a serious injury or fatality occurring. Individuals predisposed to this link are oftentimes prone to engaging in other high-risk off-duty activities, such as sky diving, racing (vehicles, boats or motorcycles), and other action oriented activities, which also fit the widely held "macho" perception and image of the fire fighter. This factor, probably more than any other, is seen as what it takes to make a fire fighter successful in their career. However, when the risk that is undertaken exceeds the benefits that can be expected, it is only a matter of time before tragedy will occur. A thorough risk assessment and fully rational decision-making must be employed each and every time we operate at an emergency scene if we are to ensure that "everybody goes home safe."

Organizational culture factors also play a role in fire fighter injuries and fatalities, and play a major role in the big picture of safety for the fire service. Over the past 25 years, these factors have been recognized as a more and more important part of the safety equation to reduce and minimize severe injuries and fatalities.

In addition to the previously listed 12 clues which influence the occurrence or non-occurrence of a serious injury or fatality there are six additional factors which have been identified as playing a substantial role in the quality of decision-making that every fire fighter will make at every incident. These additional environmental factors include:

1. **Training**

   The extent and quality of basic and continuing education training will directly influence the decision making process. The world that the fire fighter operates in is in constant change and it is a constant challenge to keep abreast of possible hazards, new systems or methods, new technology, new information, risk limitations and the changing world environment that we are required to work in. How much training has the fire fighter had since initial recruit training? What is the quantity, quality and content of training that has been received on a regular and continuing basis? In many fire departments there is a minimum amount of training that is given once a fire fighter is assigned to the field. This is typically done in those fire departments that place a strong emphasis on the belief that "experience" will give the fire fighters the necessary ongoing knowledge and skills that are required to remain safe from the hazards and risks found in the workplace. While this viewpoint has some value, most fire fighters today are attending much fewer numbers of incidents than 20 or more years ago in the average fire fighter's career.

2. **Experience**

   The typical fire fighter today has less experience than his/her counterpart of 25 years ago.

   Experience is also a nondescript term of "knowledge gained." In reality, the average fire fighter will operate (fight fires) in only a few different types of

occupancies in a whole career. There is the old adage of 25 years experience or one year, 25 times over?

Experience may also be counter-productive to improved safety if a fire fighter has engaged in a high-risk/low-frequency critical operation that did not result in a serious injury or fatality but may have only been a "near-miss". Example: Statistically you can play Russian roulette and 83% of the time nothing will happen. But, eventually you will die if you get enough experience.

3. **Attitude**

"Attitude is everything" as the saying goes. The fire fighters' attitude will play a significant role in the mental aspects of an entire operation. A positive attitude will keep the fire fighter focused and aware of his/her surroundings and improve their ability to keep the level of risk under control.

4. **Complacency**

Sometimes seen as an outgrowth of "experience", this will typically manifest itself in operations that are done by rote habit and without conscious and constant awareness of risk. Example: pulling an undersized line at a large fire out of habit, because "that's what we've always done before". It should be noted that a significant number of fire fatality incident reports written over the past 25 years have included the statement: "It was seen as a routine structure fire…." There is no such thing as a ***Routine Structure Fire***!

5. **Health**

The physical, mental, and emotional health of the fire fighter is important to the quality of decisions that will be made, or the actions that will be taken.

Work or home problems will impact the timeliness and quality of fireground decisions.

6. Peer Pressure

Peer pressure may be the most influential environmental factor in the fire fighters decision-making process. The quality, timeliness, and correctness of the actions of the fire fighter may be significantly complicated by how the fire fighter perceives what others will say about their fireground actions. For example, two fire fighters died in a fire in a residential occupancy in a northeastern metropolitan fire department a number of years ago after the landing they were on collapsed into the lower level of the occupancy. They were not seriously injured by the fall, but were disoriented and didn't know how to get out of the structure. They were both equipped with SCBA and working portable radios, but failed to call for help and eventually died when their SCBA ran out of air. The culture of the organization was such that anyone calling for help was made the subject of "friendly firehouse criticism". Is the "culture" of the fire service so strong that we would rather die than call for help when we are in trouble?

The combined fire service experience over the past 25 years has indicated that fire fighter fatality rates have not dropped. In fact, the rate of fire fighter fatalities has actually increased over this time period, despite the advancements made in protective clothing and equipment. Over that same time period significant effort has been expended to impact the technology, protective clothing, and equipment used in fire fighting to make the job safer and reduce injuries and fatalities. The fire service is slowly awakening to the concept that technology cannot overcome bad fireground management practices. Fire fighter deaths over the past 10 years seem to indicate the situation could get much worse before we truly lower the unacceptably high rate of injuries and fatalities. In order to make true

progress in lowering these appalling statistics we need to recognize that bad decisions lead to bad actions that result in bad situations.

The presence of one or more of these clues means that an error chain might be in progress and that appropriate caution and corrective action is advisable. Recognition of the presence of error chain links provides fireground crews with another tool to appropriately manage risks associated with fireground operations.

It is important to point out that identifying the presence of an error chain does not, in and of itself, eliminate the risk of a serious injury or fatality. Instead, it serves as a warning to the fire fighters that they must take appropriate action to manage the outcome of the fireground operation in the face of rising risk, and that all personnel must maintain proper control of the incident through proper management of standard operating procedures, personnel, and equipment.

Each of us has a responsibility to each other to make sure we stay safe and minimize the risk we face on an emergency scene. There is no building that is worth more than the life of a fire fighter. There is no building that is worth more than the cost of a serious injury to a fire fighter. If we are to minimize the chances for a serious injury or fatality to one of "our own" it will take the concerted efforts of everyone, 24 hours a day, 365 days a year to make sure that everyone returns safe and goes home at the end of the shift. The implementation of the concepts of Crew Resource Management in the fire service has the potential to help us improved the command, control, and communication process at emergency incident scenes. If we are successful at improving our capabilities in this most critical area, we have the opportunity to provide a better level of service to the community and also increase the level of safety to our emergency personnel in the field.