Human Factors on the Fireground; Leveraging Psychological Principles to Increase Effectiveness and Safety in Firefighting

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Created for the Fire Service Psychology Association Project Sentinel, Task Group Charlie

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Introduction: The Human Stress Response and the Fireground

The fireground is a high-stress, highly-fluid, time-pressured, dangerous environment. As such, firefighters will experience the human stress response during operations. This natural response, characterized by the physiological activation of the sympathetic nervous system and the release of adrenaline and cortisol into the bloodstream, offers some benefits during emergent situations, such as focus, energy activation, and heightened alertness.

However, these same responses also have predictable effects on cognition, perception, situational awareness, decision-making, communication, and team dynamics. If unmanaged, they can degrade performance and threaten firefighter safety.

Human factors on the fireground are not abstract academic concepts. They directly influence firefighter survivability, line-of-duty deaths (LODDs), MAYDAY events, communication failures, command breakdowns, and operational decision-making under extreme stress. Firefighters and incident commanders routinely operate in environments characterized by sensory overload, time compression, fatigue, incomplete information, emotional pressure, and rapidly changing risk profiles. Under these conditions, cognitive narrowing, tunnel vision, auditory exclusion, task fixation, and impaired situational awareness can significantly affect performance and decision quality. Many catastrophic fireground events are not solely the result of tactical failure or lack of technical competence. They often involve the interaction between human cognition, organizational culture, stress response, communication dynamics, and operational complexity. Understanding these human factors provides an opportunity to improve command effectiveness, strengthen firefighter survivability training, reduce preventable errors, and enhance overall fireground safety. Integrating human factors science into fire service training, leadership development, simulations, after-action reviews, and command education may provide one of the most impactful opportunities to improve operational performance and reduce firefighter injury and death across the profession.

Firefighters can learn methods and techniques to mitigate the negative influences of the human stress response and leverage its beneficial aspects in order to optimize their fireground effectiveness and safety.

For instance, a common negative impact of the stress response on perception and cognition includes attentional narrowing (“tunnel vision”), coupled with potential exclusion of peripheral stimuli and information. As an example, firefighters’ attention may become disproportionately consumed by specific immediate threats or tasks and lose some situational awareness. Consequently, they may not notice critical visual data unfolding around them (such as fire behavior changes, peripheral physical threats, etc.) or miss auditory information such as radio traffic or neglect to communicate information to team members on the fire ground. Attention may also anchor on the initial critical actions or threats upon arrival at the scene and firefighters may struggle to shift attention toward subsequent critical actions or threats as the situation evolves. Mitigation strategies can counteract these negative effects.

One way to describe situational awareness is the balance of keeping critical information in awareness while regularly updating awareness with new information that becomes available. This process occurs in “working memory” which is a function of the brain that, in this scenario, would be simultaneously balancing and directing firefighters’ actions, recalling training protocols/standard operating guidelines, and applying them in the moment on the fireground.

The following document provides a high-level overview of the neuroscientific, psychological, and physiological processes that shape typical reactions under stress. More importantly, it introduces learnable strategies that enable firefighters and fire service organizations to leverage the advantages of the human stress response while minimizing its drawbacks, ultimately enhancing effectiveness and safety.

The Influence of Neuroscience on Firefighting Practice and Training

The neuroscience underlying the skills firefighters depend on -- situational awareness, working memory, interpretation, and response -- provides a powerful foundation for improving performance and safety on the fireground. By understanding how the brain functions under stress, firefighters can apply targeted strategies to overcome predictable challenges.

Situational awareness is the ability to perceive, interpret, and anticipate what is happening in a dynamic environment. Each of these components is highly sensitive to the types of stressors routinely encountered in firefighting. Selective attention, for example, engages a network that includes the prefrontal cortex, parietal cortex, anterior cingulate cortex (ACC), and subcortical arousal systems. Under stress, this network shifts into a survival-oriented mode, prioritizing the most immediate or salient threat cues. While adaptive, this shift often comes at the cost of peripheral awareness, producing “attentional tunneling” or “tunnel vision.” As a result, firefighters may focus narrowly on one aspect of a scene while missing equal or greater threats elsewhere.

Even when firefighters are highly trained and possess strong knowledge of threat indicators stored in long-term memory, accessing and applying that knowledge depends on working memory. Working memory is limited—typically to about 4 to 7 items—and can be quickly overwhelmed, especially when it is simultaneously taxed by communication demands (Baddeley, 2012) and complex equipment operation.

The brain’s reliance on efficiency introduces another challenge. To rapidly interpret incomplete or ambiguous information, the brain uses cognitive schemas—internal models built from experience—to “fill in the gaps” (Endsley, 1995). While essential, this process is also a primary source of cognitive bias, leading individuals to perceive what they expect rather than what is actually present (Driskell et al., 2006).

The highest level of situational awareness, projection or prediction, relies heavily on the prefrontal cortex, which governs executive functions such as planning, inhibition, and cognitive flexibility. This stage is only as accurate as the perception and interpretation that precede it. Under stress, increased amygdala activation can disrupt prefrontal function, shifting behavior from deliberate and proactive to reactive and reflexive (Klein, 1998; Endsley, 1995).

The unique environmental, interpersonal, and internal stressors of firefighting intensify these effects. Stress hormones such as norepinephrine and cortisol degrade prefrontal cortex function, narrowing attention and reducing cognitive flexibility. They also increase attentional selectivity in the ACC, making it more difficult to disengage from dominant stimuli. At the same time, activity in the posterior parietal cortex and locus coeruleus can suppress awareness of less obvious but critical threat indicators.

Compounding this, the sheer volume of fireground stimuli—radio traffic, hazards, rapidly evolving conditions, and time pressure—places heavy demands on the dorsolateral prefrontal cortex (dlPFC), further degrading working memory and the ability to process information accurately.

Heightened amygdala activation under these conditions promotes faster, more automatic decision-making, increasing reliance on cognitive schemas and bias while reducing deliberate analysis (Arnsten, 2009).

Despite these challenges, neuroscience also points to practical, evidence-informed solutions.

On the individual level:

• Training to ensure a well-rounded knowledge base of threat indicators

• Cognitive exercises to improve working memory, particularly under stress

• Cognitive bias recognition and management

• Mindfulness training to bolster perception/awareness and emotional regulation

When practiced regularly, contemporary neuroscience suggests that we can "re-wire" our brains to more effectively address complex situations (i.e., lean on neuroplasticity to expand our range of cognitive functioning).

On the team level:

• Streamlined, shared communication practices

• Checklists

• Flexible role clarity (with protocols for "breaking role" to communicate threat identification)

These are in addition to the practices that proactively support the mitigation of physical and emotional fatigue, burnout, and vicarious trauma, each of which also compromises situational awareness and its elements.

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Impact of High-Stress, High-Danger, Time-Pressured, Loud Environments on Cognitive Load, Working Memory, and Performance

Firefighting, like other high-stress professions, faces significant and varied stressors that can have acute and prolonged impacts on firefighters' overall performance (Robinson et al., 2013). In addition to the expected stressors and dangers associated with firefighting, firefighters face environmental and occupational stressors that create physiological and psychological strain, making an already dangerous profession even more hazardous. Specifically, these stressors can negatively affect a firefighter's working memory, cognitive load, decision-making and judgement (Robinson et al., 2013). Endsley (2020) demonstrates that cognitive load significantly impairs situational awareness, especially under time pressure. First responders frequently operate in environments where sensory overload and rapid information changes are the norm, making cognitive load a central risk factor. Noise exposure has been demonstrated to have detrimental effects on attention, memory, and other cognitive processes (Jafari et al., 2019). Working in high-pressure situations has both acute and chronic effects on performance, increasing the risk of errors and reducing safety.

Multiple studies have demonstrated the impact of noise exposure on cognitive performance, specifically impacting attention, increasing fatigue, and working memory (Jafari et al., 2019). Yazdanirad et al. examined the impact of siren noise on the mental health and cognitive performance of firefighters, including an association between siren noise and depression, stress, anxiety, and aggression, with stress and aggression demonstrating the largest increase (Yazdanirad et al., 2024). In addition to the increase in mental health concerns, cognitive performance is also negatively impacted. Song et al. (2022) studied the impact of noise sensitivity and noise type on working memory, specifically accuracy and reaction time, among college students. This study found that the type of noise and an individual's sensitivity to noise had an effect on the participants' accuracy on working memory tasks. In their review of the literature, the authors discuss the irrelevant sound effect, which refers to a decrease in short-term memory performance when task-relevant noise is present (Song et al., 2022).

Firefighters face situations that create high levels of physiological and psychological stress, not only while responding to calls, but also during their shift. Stressors like irregular schedules and shift work, unpredictable work conditions, sleep deprivation, search and rescue activities, and sudden alarms. Firefighters are expected to possess cognitive skills to help them perform their job. Firefighters should have the ability to communicate effectively, remember locations in buildings, process information quickly, remain focused, and do all of this under time pressure and stress. Hemmatjo, Hajaghazadeh, Allahyari, Zare, and Kazemi (2020) looked at firefighters' performance on visual and auditory continuous performance tests and paced visual and auditory serial addition tests at baseline and after participating in a live-fire drill and revealed a decline in scores after engaging in the live-fire exercise. Their findings suggest attention, working memory, and information processing ability is impacted by firefighting operations and demonstrated a greater impact on auditory cognitive functions (Hemmatjo et al., 2020).

Chronic work stress is associated with burnout, defined as emotional exhaustion, reduced commitment and motivation, depersonalization, cynicism, and poor self-efficacy on job-related tasks (Mehrifar et al., 2025; Smith, Hughes, DeJoy, Dyal, 2018). A study done by Mehrifar, Pirami, Nkiooyan, Samimi, Avarseji, and Ramezanifar (2025) explored the impact of job stress and burnout on cognitive performance as measured by the Stroop test and CPTs. The participants consisted of 34 firefighters and 27 office workers, and the results suggest the firefighters report higher levels of burnout and stress compared to the control group and demonstrate a poorer performance on measures of attention, response inhibition. Smith et al. (2018) looked at the relationship between work-stress, work-family conflict, and burnout, noting that firefighters may not communicate effectively, express concerns about safety, follow SOPs, or perform work in a safe manner.

Marsh, Robinson, Vachon, Pugh, Sörqvist & Ljungberg (2025) examined the impact of acute stress among firefighters on sustained attention, which revealed an association between acute stress and increased vulnerability to distraction. Interestingly, firefighters were found to be more vulnerable to auditory distraction, which improved with recovery from stress exposure (Marsh et al., 2026). The relationship between acute stress and job performance issues has been demonstrated in other high-risk, high-stress fields, including health care and law enforcement. Frazier and Parker (2019) reviewed several studies that highlighted psychological and physiological responses to acute stress situations and noted that individuals may not be aware of decreases in performance, judgement, or decision-making.

In sum, the nature of the fire service places increased stressors and demands on firefighters. The situations and dangers that firefighters are in can lead to emotional exhaustion, burnout, and acute and chronic stress reactions. Each of these experiences can negatively impact the cognitive processes necessary for keeping firefighters safe, namely attention, information processing, and working memory. Furthermore, firefighters operate within loud environments, with sirens, alarms, and other job-related noises that can increase distraction.

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Human Decision-Making Processes and Fireground Operations

Human decision making is best understood as operating on two interacting tracks. One track is fast, automatic, and pattern based. It relies on recognition, habits, and learned cues. It works well under time pressure, but it can misfire when cues are incomplete or when a situation only looks familiar (Kahneman, 2011).

The second track is slower, deliberate, and analytic. It supports comparison of options, explicit risk tradeoffs, and checking assumptions. It demands attention and working memory. It degrades with fatigue, high arousal, and competing tasks (Kahneman, 2011).

High risk work rarely allows full analysis. Instead, experienced operators often use naturalistic decision making. They recognize patterns, generate a workable first option, and mentally simulate whether it will succeed. This approach aligns with the recognition primed decision model (Klein, 1993).

U.S. firefighting Mindset and Culture Related to Decision-Making

Culture should be analyzed as a performance-shaping factor. Firefighters do not make decisions in isolation. They make decisions inside identity-based systems and organizational cultures that reward certain behaviors and discourage others.

Fire service identity and culture can shape risk perception. For instance, firefighters may continue offensive operations, delay withdrawal, avoid declaring a Mayday, or hesitate to challenge an unsafe decision because those actions conflict with the internalized identity of being aggressive, dependable, tough, and mission-focused. Fire service culture is not bad; it creates courage, cohesion, pride, and performance. The risk appears when identity narrows decision-making and makes disengagement, reassessment, or speaking up feel like weakness.

U.S. firefighting culture rewards action, competence, and loyalty to the crew. It also values aggressiveness, speed, and identity-based pride tied to being the person who goes in. Those norms can strengthen performance in rapidly evolving conditions, especially when they support disciplined training, strong supervision, and clear command intent.

The same norms can also increase risk tolerance. U.S. Fire Administration work on risk-taking describes how attitudes, informal expectations, and role norms can push members toward accepting elevated risk, even when policy language exists (U.S. Fire Administration, 2012).

On the fireground, this culture often supports rapid decisions built from experience. It also increases the chance of “doing what we always do” when conditions call for a reset, a defensive pivot, or a pause to regain situational awareness.

Stress Response and Firefighter Mindset Effects on Fireground Decision-Making

Acute stress changes cognition and behavior. Attention narrows. People fixate on the most salient cues and miss weak signals. Working memory capacity drops, which reduces the ability to track benchmarks, air, time, location, radio traffic, and crew assignments at once (Regehr & LeBlanc, 2017). Moreover, Power and Alison (2021) demonstrate that emergency responders rely heavily on recognition-primed decision-making, which can be disrupted by stress, ambiguity, or information overload.

Stress also shifts decisions toward speed over accuracy. That can help early in fast moving operations. It can also increase errors when the situation becomes ambiguous, when conditions deteriorate, or when the incident exceeds span of control (Regehr & LeBlanc, 2017).

Firefighter culture can amplify this pathway in predictable ways.

- Identity pressure can discourage an early switch from offensive to defensive.
- Crew loyalty can push companies to extend commitment past realistic margins.
- Informal bravado norms can reduce speaking up, which delays correction of a bad plan.

These effects are not character flaws. They are human factors. They respond well to good systems.

Methods to Optimize Fireground Decision-Making with Dynamic Risk Assessment

Dynamic risk assessment treats risk evaluation as continuous. It does not treat size up as a single event. It requires ongoing hazard identification, control selection, monitoring, and revision as conditions change (Tissington & Flin, 2005). UK incident command doctrine describes dynamic risk assessment as continuous assessment during incident operations, linked to command decision control processes (U.K. Department for Communities and Local Government, 2008).

Operationalizing this on the fireground usually means building repeatable decision controls that work under stress.

- Use a standard decision cycle. Identify hazards, assess risk, apply controls, then review and revise as conditions evolve (Tissington & Flin, 2005).
- Set explicit trigger points. Tie actions to observable benchmarks such as fire location, structural stability indicators, air consumption trends, and progress timelines.
- Require command talk-through at intervals. Force a brief verbal update that includes strategy, priorities, risk level, and next actions. This reduces silent drift.

- Strengthen incident management structure. Clear roles, communications discipline, and accountability systems support higher quality decisions (National Fire Protection Association, 2020).
- Train recognition with simulation. Recognition primed decision skills improve when training builds varied experience patterns, followed by structured debrief (Klein, 1993).
- Build after-action learning that targets decision points. Use dynamic risk assessment as a debrief framework. Ask what cues were seen, what cues were missed, and what controls worked (Tissington & Flin, 2005).

Recommended Broad Adaptations to Firefighter Culture and Mindset to Improve Safety and Decision Quality

Cultural change works best when leaders tie it to identity and competence. The aim is not caution as timidity. The aim is disciplined aggression with controlled risk.

At the department level, the most reliable adaptations are system-backed norms.

- Define "professional" as risk disciplined. Reward crews for clean execution, communication, and restraint when benchmarks fail.
- Normalize speaking up. Teach and require respectful challenge when conditions shift or controls fail. Reinforce that dissent can be loyalty.
- Shift prestige from "always offensive" to "always effective." Promote the idea that switching modes based on evidence is a mark of mastery.
- Make command decision quality visible. Coach officers on decision controls, not just tactics. Evaluate decisions using the same model used in training.
- Reduce bravado reinforcement. Correct informal messaging that equates safety actions with weakness. Replace it with a performance narrative tied to survival and mission success.
- Build stress inoculation into training. Add time pressure, ambiguity, and comms load, then practice the same decision cycle and reset behaviors used on real incidents (Regehr & LeBlanc, 2017).

These adaptations align culture with how humans actually decide under threat. They also support the continuous risk posture embedded in dynamic risk assessment models (Tissington & Flin, 2005).

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Communication in Dangerous Situations

The physiological stress response impacts communication during and after stressful situations. In this review, while we observe this from the lens of first responder communication in dangerous incidents, there are scant empirical studies on fire personnel communication in the middle of critical incidents. As such, the research explored looks at both first responders and non-first responders in stressful situations.

Physiologically, stress triggers the brain's hypothalamus–pituitary–adrenal (HPA) axis which releases stress-related hormones (i.e., glucocorticoids). These stress hormones increase heart rate and cortisol levels. Arnsten (2009, 2015) showed that these stress hormones actually impede prefrontal cortex functioning (i.e., human ability for more reflective, higher-order thinking), and increase amygdala functioning (i.e., the reflexive response for flight/flight/freeze). While stress arousal gives a flood of energy and vigilance and awareness in the middle of a dangerous situation, some cognitive functions can experience impairment. Some functions that suffer are visual processing of peripheral information (i.e., "tunnel vision", AlSaqr & Dickinson, 2017), lower executive functioning (i.e., long-term problem solving, McCormick et al., 2007), and increased difficulty with incorporating feedback (Akinola & Mendes, 2012).

Brown et al. (2009) recorded that physicians experience stress and even increased heartrate simply when giving their patients bad news. In a more intense scenario, Arble et al. (2019) did a study with 17 police cadets during a simulation of an officer death. The cadets measured with increased heart rates and higher cortisol levels. In regards to functioning, Arble et al. found that under stress, tactical performance and nonverbal communication remained good in the cadets, but verbal communication suffered.

Verbal communication during a dangerous situation requires many aspects of cognitive processes to be in play. Semantic, working, and declarative memory add to clarity and complexity of speech. Saslow et al. (2014) found that when people become stressed, their higher heart rate, emotional stress reactivity, and higher cortisol levels lead to them to have difficulty with verbal communication (i.e., "lower linguistic complexity"), which means people give fewer details, make fewer distinctions or qualifications, and re less able to synthesize ideas.

When a person experiences acute stress, some memory functioning is also impaired (i.e., semantic and declarative memory, Sandi and Pinelo-Nava, 2007; Morgan et al., 2004; Taverniers et al., 2013). Andre et al. (2016) looked at communication differences in nurses in stressful versus non-stressful situations. Stressful situations led the nurses to be less engaged, have lower empathy, lower loyalty, and lower task-orientation, while simultaneously express higher "creativity" – or doing it their own way (i.e., "spontaneous, non-compliant problem solving") and not ask others to contribute.

Verbal communication is also impacted post-incident. Hope (2016) found that inaccurate officer reporting in post-incident reports and debriefing is due to the memory impairment, stress response, and fatigue that impairs verbal communication. Taverniers et al. (2013) did an

experiment with Special Forces personnel and found that 24 hours after the cortisol experience, there was still significant cognitive impairment (i.e., specifically, visuo-spatial declarative memory recall).

In summary, being in a state of physiological arousal increases heart rate, as well as catapults the level of stress hormones, which negatively impacts memory and lowers the ability to use complex speech or communicate empathy. Interestingly, stress has not been seen to impact tactical performance and nonverbal communication.

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Team Dynamics on the Fireground

Effective fire ground operations depend on highly coordinated team dynamics that support rapid decision-making, safety, and task execution in complex, high-risk environments. Firefighters operate under time pressure, uncertainty, physical danger, and cognitive overload, making team processes critical determinants for performance and injury prevention. Strong leadership promotes reduced operational errors and improved safety outcomes (Bigley & Roberts, 2001; NFPA, 2023). Key objectives include:

- Clearly defined roles and responsibilities
- Decisive but flexible leadership
- Consistent command presence and communication

Clear communication uses shared situational awareness and reduces cognitive overload in high-noise, low-visibility environments (Klein, 2015). Salas et al. (2020) highlight the importance of shared mental models, communication discipline, and role clarity in reducing errors. These findings support structured communication tools (e.g., condition, actions, and needs (CAN) reports, personal accountability reports (PAR) as human-factor interventions.

Effective fireground teams rely on:

- Brief, standardized radio communications
- Closed-loop communication (confirmation of messages)
- Face-to-face updates when possible

During stressful incidents firefighters use recognition-primed decision-making to select appropriate tactics based on the assessed situation and fire behavior indicators. This includes reassessing risk versus benefit throughout the incident and recommending tactical adjustments when conditions deteriorate. (Klein, 1998). Although various prevention methods have been defined and put into place, deaths have not decreased over the years, fire ground injury rates have held steady, and stress levels are increasing (Carlisle, 1999). This lack of improvement confirms the need for new strategies that promote wellness, awareness, and effective personal reactions to incident-related stress. The combination of positive leadership and increased emotional intelligence (EI) has shown promise (Couper, 2013).

Five key elements of EI and how these might be applied within fire leadership have been defined: Self-awareness, self-regulation, motivation, empathy, and social skills (Lorber, 2013). The three most critical EI skills in a fire supervisory role are conflict resolution, good communication, and praise of others. By studying firefighter protocol, a comprehensive EI foundation can be established that is generic to firefighter tasks, which can be then used to promote and customize related EI training programs. Some have even suggested that EI assessment be part of the hiring process (Carlisle, 1999). EI training helps firefighters:

- Make better decisions under stress

- Communicate clearly on chaotic scenes
- Reduce conflict in the firehouse
- Support mental health and resilience
- Develop strong future officers

How one thinks and makes decisions on a physical, emotional, and social level delineates the consequences and reinforces the role that emotional intelligence (EI) plays in job performance, wellness, and survival. The direct and indirect benefits and effects defined through using EI to reduce firefighter/paramedic stress provides a promising solution to the risk of potential hidden health issues and early death that plagues the fire service industry. Overall, fireground teams must balance standard operating procedures (SOPs) with adaptive decision-making.

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Mindfulness as a Mitigation

Mindfulness may be a useful instrument to mitigate the negative effects of the human stress response and help firefighters optimize performance and safety. Mindfulness is often described as awareness of what is happening within us and around us, just as it happens in the moment. Typically, only a fraction of our attention is engaged with the present moment, while other aspects of our attention are ruminating on past events, focused on possible future events, or engaged in distracting internal thought dialogues. Mindfulness gathers our attention into the present moment, allowing us to become increasingly more aware of what is happening within us (internal data) and more aware of what is happening in our environment around us (external data). As such, the state of increased mindfulness allows us to gather and assess internal and external data more accurately and harness our gathered attention to engage with the environment more effectively and with less reactivity. One of the most powerful but elusive aspects of mindfulness is that it is available to us anytime, anywhere, under any circumstances – including during fireground operations – we just need to tap into it, which is easier said than done. While mindfulness is always present and available, we are not always conscious of it.

The origins of the concept of mindfulness stem from Eastern introspective practices, specifically Buddhist meditation practices from over 2,500 years ago. Over the past forty years, the traditional or classical concept of mindfulness has been adapted and applied within many Western psychological contexts ranging from stress management practices to psychotherapeutic treatments to workplace effectiveness and sports performance programs.

Mindfulness as a state of being is a process or a skill which can be incorporated into everyday activities. Our ability to access and apply mindfulness is strengthened through practice, such as through mindfulness meditation. Mindfulness meditation training and mindfulness practices have demonstrated increased positive effects in performance within occupations and activities similar to firefighting. For instance, the work of Jha, Zanesco, and others at the JHA Lab have consistently demonstrated beneficial effects of mindfulness training, such as increased cognitive resilience, psychological executive function, attention, and working memory, for U.S. military servicemembers, including elite special operations forces, who operate within highly stressful, high-demand work environments similar to firefighting. In fact, Denkova, Zanesco, Rogers, and Jha (2020) applied their mindfulness training in a study of firefighters which demonstrated positive impact consistent with mindfulness training in similar professions, such as increased cognitive resilience, psychological executive functioning, and objective attentional task performance.

The effectiveness of mindfulness training for high-risk professions appears most effective when it is contextualized by experts and trainers who are culturally competent or familiar with the context of the high-demand work.

Fireground Applications of Mindfulness

In this context, applied mindfulness on the fireground is a professional competence on the individual, team, and organizational level. Applied mindfulness is a trained ability to employ brief repeatable cognitive and team techniques to increase effectiveness and safety.

Some examples of applied mindfulness at the individual level include:

Mindfulness can serve as a cognitive stabilizer helping firefighters notice stress response activation, identify and gather internal data, temper reactivity, focus attention, expand working memory, and more effectively engage higher order cognition and brain executive function, even under time pressure and duress. For example, mindfulness skills could help a firefighter detect attentional narrowing, then respond by re-expanding awareness to include peripheral information then intentionally shift attention and adapt his or her behavior as external cues and conditions evolve.

Mindfulness bolsters working memory in action, thereby helping firefighters more effectively juggle the simultaneous mental demands of reading environmental cues, interpreting fire behavior, processing radio traffic, recalling SOGs and training, and tracking air, time, location, and tasks.

Mindfulness enhances emotional regulation helping firefighters identify and regulate internal reactive states. For example, applied mindfulness could help firefighters notice when well-intentioned determination starts driving overly aggressive tactics, identify panic driven urgency, recognize emotionally-driven escalation of commitment, and soften defensiveness to taskings, challenges, or feedback.

At the team and organizational level, mindfulness promotes improved teamwork, communication, resilient effectiveness during prolonged or complex incidents, psychological safety, and a culture of learning and continuous improvement.

Mindfulness can help build disciplined aggression. It does not infuse hesitation, but rather bolsters pro-active, informed behaviors and decisions. Lastly, mindfulness techniques are applicable across the lifecycle of the fireground from pre-incident grounding or readiness habits or rituals, “in the moment” during operations, and enabling post-incident decompression and after-action learning.

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Adapting Psychological Safety and Crew Resource Management

Crew Resource Management (CRM) has been widely credited with improving safety in high-risk industries by shifting the focus from individual technical competence to team cognition, communication discipline, and error management under stress (Helmreich & Foushee, 2010). The term Fireground Human Factors (FHF) is proposed here as a conceptual framework for adapting established human factors principles to the operational realities of the fireground. Its core insight is that incidents rarely result from a single mistake; rather, they emerge from systemic breakdowns in shared understanding, coordination, and information flow (Reason, 1997). For the fire service, the value of CRM lies not in importing aviation practices wholesale, but in adapting its underlying human factors principles to the realities of the fireground: time pressure, degraded visibility, high noise, thermal stress, and rapidly evolving risk. A fire-specific framework should therefore concentrate on practical, observable behaviors that enhance collective performance, including structured communication, deliberate information sharing, and leadership practices that support upward voice.

A central contribution of CRM is the concept of shared situational awareness (Endsley, 1995). On the fireground, situational awareness cannot be assumed simply because personnel are co-located. Smoke, heat, alarms, radio traffic, and cognitive overload degrade perception. Under stress, attention narrows and individuals fixate on their immediate task, often missing peripheral cues (Driskell & Salas, 1991). Experience further shapes interpretation: two firefighters may perceive identical smoke conditions differently based on prior exposure or expectation. Naturalistic decision-making research demonstrates that experienced operators rely on pattern recognition shaped by prior incidents, which can both enhance rapid judgment and constrain perception (Klein, 1998). Shared situational awareness must therefore be actively constructed through communication. Verbalizing observations, confirming task status, and updating intent allow teams to align their mental models. Closed-loop communication, in which instructions are acknowledged and completion confirmed, reduces ambiguity, improves team coordination, and helps maintain a common understanding of operational goals and actions (Lee et al., 2025).

Another major contribution of CRM is the creation of environments in which junior personnel feel able to raise safety concerns. In organizational research this is often termed psychological safety - the shared belief that speaking up will not result in embarrassment or punishment (Edmondson, 1999) - but operationally it translates to disciplined professional candor: the expectation that anyone who identifies a hazard speaks up early and clearly. For the fire service, this requires explicit assertiveness training adapted to rank structure, supported by leadership behaviors that actively invite and respond constructively to input. This is not about diluting command authority; it is about improving information flow in environments where perceptual limits and workload saturation are inevitable. By adapting CRM principles into fireground-specific behaviors, the service can strengthen team coordination, reduce preventable error, and enhance operational safety without compromising command clarity.

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Applying Dynamic Risk Assessment

In 2023, Chicago (IL) Firefighter Drew Price was killed while working on the roof of a four-story building fire when he inadvertently fell down an open shaft. Illinois OSHA was charged with investigating the death and determining if a violation of health and safety regulations occurred. Despite the vast number of regulations available, Illinois OSHA did not identify a specific regulation that could legally be applied to work-at-height during emergency response; the regulations were simply too prescriptive.

This failure of the US occupational safety and health regulatory framework prompted questions on how the United Kingdom's Health and Safety Executive (HSE) would have approached a hypothetical similar incident. A landmark 1972 document known as the Robens Report assessed the occupational safety and health regulatory framework within the UK (Robens, 1972). The report recommended a fundamental change with less focus on myriad prescriptive standards, and more on assessing and controlling risk. Robens' work paved the way for the modernization of health and safety regulations in the UK and resulted in the UK Health and Safety and Work Act of 1974 (Sirrs, 2016).

Risk-based health and safety regulations in the UK require incident commanders to perform dynamic risk assessment (DRA) at every incident (Tissington & Flin, 2005). DRA was introduced to the UK fire service in 1998 through a pamphlet: The Dynamic Management of Risk at Operational Incidents (United Kingdom Home Office, 1998). DRA is a systematic method for assessing and controlling risks when faced with time pressure, incomplete information, and a changing environment. It is a core principle within the UK National Operational Guidance for Incident Command (National Fire Chiefs Council, 2020). DRA begins by evaluating the situation and deciding who might be harmed and how. Next, the incident commander must make a judgement to see if the benefits of action are proportional to the risks. If the risk/benefit is judged to be appropriate, the incident commander must select a safe system of work with control measures to reduce risks. The incident commander must then declare an offensive or defensive mode, confirming completion of the initial DRA as required by law. Throughout the incident they perform an ongoing assessment of risk/benefit, adjust the operational mode if warranted, add additional or alternative control measures, and continually cycle through the DRA process.

DRA has been accused of being subjective and difficult to measure scientifically. There is not a wealth of peer-reviewed literature about DRA, however, a study of 16 incident commanders across two countries revealed that dynamic risk assessment is not a simple process of weighing risk versus benefit, but rather an experiential and pattern recognition process (Okoli et al., 2016). In other contexts, DRA has been described as a human-factors–dependent cognitive process requiring continuous monitoring, adaptive thresholds, integration of human and environmental cues, and rapid updating of mental models.

Another study of operational commanders exclusively in the UK determined that decision-making did not follow a strict structured sequence of dynamic risk assessment but instead was influenced by both reflective and reflexive processes (Cohen-Hatton et al., 2015). The limitations

of these studies are that the participants worked in countries with risk-based occupational safety and health regulations where risk assessments have been a regular expectation for decades. This practice is in contrast to the prescriptive nature of occupational safety and health regulation in the United States (Burgess et al., 2014).

Based on the results of the International Fire Service Incident Command Survey (IFSICS) conducted in 2022-2023, US fire service incident commanders (n =442) had a significantly higher risk appetite than their UK counterparts (n = 681) and the safety attitudes of US participants were significantly more likely than UK participants to reflect risk acceptance and the inevitability of firefighter injury (Kambarian et al., 2025). Based on the results of IFSICS, a research study was launched in February 2026 between Cardiff University (UK) and the University of Illinois Fire Service Institute that will measure incident commander performance during video-based incident scenarios after participants complete a 20-minute control course or a 20-minute intervention course that was designed to teach the concepts of DRA to US firefighters. The intervention course is focused on three simple DRA concepts: identify hazards, assess risk (how likely and how bad) and defend against harm. This process can be applied at the incident command level as well as at the individual firefighter level.

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Next Steps – The Way Forward

This document sets the foundation. Follow-on efforts will focus more deeply on application and expand further upon the operational and organizational techniques and implications offered in this work. The fire service is best served through incorporating mitigations for these neuroscientific, psychological, and physiological phenomena into fire service training, leadership development, simulations, after-action reviews, and command education. Mitigation strategies should be implemented beginning at the tactical level, such as techniques for individual firefighters, and incorporated across all levels of the fire service up to the strategic organizational level, influencing adaptations for the U.S. fire service at the identify and culture levels. While some principles and applications will be universally relevant across the entire U.S. fire service, other application efforts will need to be contextualized. For instance, some operational and organizational adaptations driven by these insights will take shape differently within the context of a major city fire department vs a small town fire department vs an all-volunteer fire department vs wildland firefighting. The way forward is putting these insights into action.

Fireground Human Factors Analysis Actionable Guidelines

Based on the content of Human Factors on the Fireground - June 2026.pdf, below are **clear, structured, and actionable guidelines** for conducting a **Human Factors Analysis (HFA)** for fireground operations, including routine after action discussions and also following a firefighter fatality or serious injury during fire suppression operations. These guidelines are best applied in conjunction with the solutions, mitigations, and recommendations previously noted in *Human Factors on the Fireground; Leveraging Psychological Principles to Increase Effectiveness and Safety in Firefighting*.

These guidelines offer fire service personnel a practical way to examine human performance on the fireground without drifting into blame or falling prey to hindsight bias (judging actions based on information which is known now but was not known at the time and not considering the conditions/context occurring at that time). This guide helps explore why actions made sense to personnel at the time based on the information, pressure, culture, training, and command structure present during the event.

This guide is intended to support structured learning after fireground operations. It should be used to identify human, organizational, cultural, and system factors that shaped performance. It is not intended to assign blame or replace formal investigation requirements. Appendix A is a worksheet providing a structure to facilitate reviews and discussions. Appendix B provides a brief, checklist-only version of the worksheet. Appendix C offers a ready-to-use training slide deck content to apply the principles of *Human Factors Analysis on the Fireground*.

[Human Fact...June 2026 | PDF]

Human Factors Analysis Guidelines

(Routine After Action Review/Firefighter Fatality / Serious Injury – Fire Suppression)

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1. Purpose and Scope of Analysis

- Determine **how human factors influenced the outcome**, not just what happened.
- Focus on **interactions between the environment, systems, people, and stress**, rather than assigning blame.
- Recognize that incidents often result from **systemic breakdowns in cognition, communication, coordination, and culture** rather than a single error. [Human Fact...June 2026 | PDF]

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2. Establish Context of the Incident

Document operational conditions known to affect human performance:

Environmental Stressors

- Time pressure and rapidly changing fire conditions
- Noise (alarms, radios, apparatus)
- Visibility limitations (smoke, darkness)
- Physical stress (heat, fatigue, air supply limits)

Organizational Context

- Command structure and span of control
- Staffing levels and experience mix
- Training, SOPs, and cultural norms (e.g., aggressiveness, risk tolerance)

Fireground environments create **sensory overload, cognitive strain, and incomplete information**, which directly shape decision-making and safety outcomes. [Human Fact...June 2026 | PDF]

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3. Analyze Cognitive and Perceptual Factors

3.1 Situational Awareness

Evaluate the three levels:

- **Perception:** What cues were available vs. what was noticed?
- **Comprehension:** Were cues interpreted correctly?
- **Projection:** Were future conditions anticipated?

Look for:

- Tunnel vision / attentional narrowing
- Missed or discounted cues
- Failure to update situational awareness as conditions changed [Human Fact...June 2026 | PDF]

3.2 Cognitive Load and Working Memory

For crew personnel:

- Were crew members overloaded by multiple demands (radio traffic, tasks, hazards)?
- Had difficulty tracking key parameters, such as location, air supply, assignments, and benchmarks?
- What mitigation techniques did crew members utilize & were they helpful or not?

For Incident Commander (IC) and command staff:

Assess to what extent the IC and command staff had sufficient command support, manageable span of control, reliable information flow, and enough cognitive bandwidth to reassess strategy as conditions changed. Think in cycles: Assess-> Communicate -> Re-Assess

Suggested review questions:

- Was the IC managing too many tactical, radio, accountability, and strategic functions at once?
- Was command support assigned early enough?
- Did span of control exceed practical limits?
- Were benchmarks clear, tracked, and repeated?
- Did the IC receive timely information from all divisions and groups?
- Did command update the strategy when conditions changed?
- Were command checklists or tactical worksheets used?

Working memory is limited and degrades quickly under stress and multitasking. [Human Fact...June 2026 | PDF]

3.3 Decision-Making Processes

Identify:

- Effective use of **recognition-primed decisions** vs. analytical thinking
- Whether:

    - Decisions were appropriate for the situation
    - Pattern recognition was misapplied due to incomplete cues
    - At junctures where time allowed, were options considered to find the best solutions vs. first viable actions?
- Indicators of:
    - Over-reliance on “what usually works”
    - Failure to reassess strategy

Under stress, decision-making shifts toward **fast, automatic processes**, increasing risk of error in ambiguous or evolving conditions. [Human Fact...June 2026 | PDF]

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4. Evaluate Stress Effects on Performance

Key Effects to Identify

- Reduced cognitive flexibility
- Fixation on immediate threats
- Impaired judgment and memory
- Overcommitment or escalation of risk

Behavioral Indicators

- Task fixation
- Delayed defensive transition
- Missed radio communications
- Reduced ability to process new information

Stress hormones degrade higher-order thinking and increase reactive behavior. [Human Fact...June 2026 | PDF]

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5. Communication Analysis

5.1 Operational Communication

Assess:

- Clarity, brevity, and accuracy of radio transmissions
- Use of **closed-loop communication** (acknowledgment and confirmation)
- Frequency of updates from crews and command
- How did communication build shared situational awareness across crew members?
- To what extent were all personnel, including junior members, empowered to raise concerns and state observations?

5.2 Stress Impact on Communication

Identify:

- Reduced verbal detail or clarity
- Missed or misunderstood messages
- Lack of critical information sharing
- Lack of shared situational awareness

Stress reduces linguistic complexity and can impair verbal communication even when tactical performance appears intact. [Human Fact...June 2026 | PDF]

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6. Team Dynamics and Coordination

Evaluate:

- Role clarity and accountability
- Command presence and leadership effectiveness
- Alignment of team mental models (shared understanding) across all crew members as their teamwork and attack strategy unfolded
- Effective disagreement/conflict resolution across crew personnel, command staff, mutual aid responders

Look for:

- Breakdowns in coordination
- Independent or “freelancing” actions
- Failure to communicate observed hazards

Effective teams rely on **shared situational awareness and disciplined communication** to prevent errors. [Human Fact...June 2026 | PDF]

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7. Cultural and Organizational Influences

Culture should be analyzed as a performance-shaping factor. Firefighters do not make decisions in isolation. They make decisions inside identity-based systems and organizational cultures that reward certain behaviors and discourage others.

Key questions:

- What behaviors receive informal approval in this organization?
- Did personnel feel pressure to continue operations because of identity, pride, reputation, or crew expectations?
- Did anyone hesitate to challenge a decision or report unsafe conditions?
- Does withdrawal, tactical reset, or Mayday declaration carry perceived social cost?
- Did the organization reward disciplined risk management as strongly as aggressive action?
- Which culture and mindset adaptations listed in *Human Factors on the Fireground* would have improved performance in this incident?

Assess how culture influenced decisions:

Key Cultural Factors

- Aggressive interior attack norms
- Reluctance to switch to defensive strategy
- “Hero” or identity-driven risk taking
- Resistance to speaking up

Indicators

- Continuing operations despite deteriorating conditions
- Lack of challenge to unsafe decisions
- Overcommitment to initial strategy

Fire service culture can increase **risk tolerance and delay corrective action** under certain conditions. [Human Fact...June 2026 | PDF]

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8. Dynamic Risk Assessment (DRA)

Evaluate whether risk was actively managed:

Key Questions

- Were hazards continuously identified and reassessed?
- Were **risk vs. benefit decisions explicitly articulated?**
- Were **trigger points** established (e.g., time, fire spread, structural integrity)?

Failure Indicators

- Static size-up with no reassessment
- Lack of strategic adjustment
- Missing or unclear benchmarks

Effective fireground safety requires **continuous risk evaluation and adjustment**, not a one-time size-up. [Human Fact...June 2026 | PDF]

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9. May Day Cognition and Survival Decision-Making

Mayday performance should be analyzed through cognition, identity, and survivability. The stress response, disorientation, communication, and identity-based hesitation are all factors at play. Reviewers should examine whether firefighters recognized the emergency, accepted the severity of the situation, overcame hesitation, communicated clearly, and activated survival procedures in time.

Suggested review questions:

- What cue first indicated the firefighter was in danger?
- Was that cue recognized as a survivability threat?
- Did the firefighter continue task work instead of transitioning to survival action?
- Was there hesitation before the Mayday?
- Did crew culture support early Mayday declaration?
- Did command have a Mayday tactical worksheet or checklist?
- Did radio procedures protect the Mayday channel?

- Were RIT/RIC (Rapid Intervention Team/Crew) actions coordinated with accountability and command priorities?

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10. Error Pathway Reconstruction

Rather than identifying a single cause:

- Map the **sequence of human factors interactions**:
    - Two examples:

      Stress response → cognitive narrowing → missed cue → flawed decision → delayed correction

      Stress response -> awareness of negative impact on performance -> mitigation technique employed -> beneficial impact -> positive outcome
- Identify:
    - Missed opportunities for intervention
    - Compounding small breakdowns

Most incidents result from **layered human and system interactions**, not isolated mistakes. [Human Fact...June 2026 | PDF]

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11. Organizational Learning and Recommendations

Develop Recommendations that:

- Target **systems and processes**, not individuals
- Improve at the system level:
    - Communication discipline, norms, and expectations
    - Decision-making frameworks
    - Training under stress
    - Command structure and accountability
    - Team dynamics
    - Organizational culture, mindset, and norms

Key Focus Areas

- Standardized decision cycles
- Simulation-based training and stress exposure
- Reinforcement of speaking up (psychological safety)
- Use of checklists and benchmarks

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12. After-Action Review Integration

Structure reviews around:

- What cues were present vs. missed
- What decisions were made and why
- How the stress response and cognitive load affected performance
- How was risk managed across the lifespan of the incident
- Where communication and team dynamics were sub-optimal
- What mitigation techniques were employed, how they helped, and what additional mitigation techniques could be employed

After-action reviews should explicitly analyze **decision points and human performance factors**. [Human Fact...June 2026 | PDF]

Summary Framework (Quick Reference)

Analyze the Incident Through These 6 Lenses:

1. Environment & stress conditions
2. Cognition (situational awareness, memory, bias)
3. Decision-making processes
4. Communication effectiveness
5. Team dynamics & leadership
6. Culture & risk tolerance

Appendix A

Below is a **structured, field-ready Post-Incident Human Factors Review Worksheet** derived directly from the principles in your provided document. It is designed for **LODD, near-miss, or serious injury investigations** and can be used in debriefs, formal investigations, or training reviews.

🔥 **Post-Incident Human Factors Review Worksheet**

Fire Suppression Operations (Fatality / Serious Injury)

SECTION 1: INCIDENT OVERVIEW

Incident Name/Location:
Date/Time:
Type of Incident:
☐ Residential ☐ Commercial ☐ High-rise ☐ Industrial ☐ Other: _____

Outcome:
☐ Fatality ☐ Serious Injury ☐ Near Miss

Personnel Involved:

- Injured/Deceased:
- Crew/Company:
- Incident Commander:

Operational Mode at Time of Event:
☐ Offensive ☐ Defensive ☐ Transitional ☐ Unknown

SECTION 2: ENVIRONMENTAL & STRESS CONDITIONS

Check all that applied and describe impact:

☐ High heat conditions
☐ Low visibility / smoke conditions
☐ High noise (alarms, radios, apparatus)
☐ Time pressure / rapidly changing conditions
☐ Fatigue / long operational period
☐ Complex structure/layout

Notes / Observations:

Fireground environments commonly involve **sensory overload, time compression, and incomplete information**, which degrade performance. [Human Fact...June 2026 | PDF]

SECTION 3: SITUATIONAL AWARENESS

3.1 Perception (What was noticed?)

- What critical cues were present?
- Which cues were missed or not recognized?

Findings:

3.2 Comprehension (What did personnel believe was happening?)

- Were conditions interpreted correctly?
- Were fire behavior or structural indicators misunderstood?

Findings:

3.3 Projection (What was expected to happen next?)

- Did personnel anticipate changes in conditions?
- Were future hazards recognized?

Findings:

Indicators of Degraded Awareness:

☐ Tunnel vision / attentional narrowing
☐ Task fixation

☐ Failure to update size-up
☐ Missed environmental cues

Stress often causes **attentional narrowing and missed peripheral information**, reducing situational awareness. [Human Fact...June 2026 | PDF]

SECTION 4: COGNITIVE LOAD & WORKING MEMORY

Assess whether personnel were overloaded:

☐ Tracking multiple assignments simultaneously
☐ Managing radio traffic and tactical tasks
☐ Monitoring air / time / location
☐ Operating equipment under stress

Evidence of overload: ☐ Missed radio messages
☐ Confusion about assignment/location
☐ Loss of situational tracking

Findings:

Working memory is limited and **degrades under stress, multitasking, and noise exposure**. [Human Fact...June 2026 | PDF]

SECTION 5: DECISION-MAKING

Decision Type Observed:

☐ Recognition-primed (experience-based)
☐ Analytical (deliberate)
☐ Mixed

Evaluate:

- Were decisions appropriate for conditions?
- Was there evidence of “doing what we always do”?
- Were assumptions challenged or verified?

Findings:

Indicators of Decision Breakdown:

☐ Failure to reassess strategy
☐ Continued offensive operations beyond safe limits
☐ Delay in changing tactics
☐ Misinterpretation of cues

Under stress, decision-making shifts toward **fast, automatic processes**, increasing risk in complex situations. [Human Fact...June 2026 | PDF]

SECTION 6: STRESS RESPONSE EFFECTS

Check observed behaviors:

☐ Fixation on one task/threat
☐ Loss of flexibility or adaptability
☐ Increased urgency or aggressive actions
☐ Emotional or reactive decision-making

Findings:

Stress responses impair higher-order thinking and increase **reactive, less flexible behavior**. [Human Fact...June 2026 | PDF]

SECTION 7: COMMUNICATION ANALYSIS

7.1 Communication Effectiveness

☐ Clear and concise radio transmissions
☐ Closed-loop communication used (acknowledgment/confirmation)
☐ Regular status updates

7.2 Communication Breakdown Indicators

☐ Missed or ignored messages
☐ Lack of clarity or detail
☐ Failure to share critical information
☐ Overly complex or excessive radio traffic

Findings:

Stress can reduce **verbal clarity and complexity**, leading to communication failures. [Human Fact...June 2026 | PDF]

SECTION 8: TEAM DYNAMICS & COORDINATION

Evaluate:

☐ Clear roles and responsibilities
☐ Strong command presence
☐ Shared understanding of strategy
☐ Effective coordination between crews

Breakdown Indicators:

☐ Freelancing or independent action
☐ Confusion about assignments
☐ Lack of accountability tracking
☐ Failure to communicate hazards

Findings:

Effective teams require **shared situational awareness and disciplined communication**. [Human Fact...June 2026 | PDF]

SECTION 9: CULTURE & RISK PERCEPTION

Assess cultural influences:

☐ Pressure to continue offensive operations
☐ Reluctance to switch strategy
☐ Identity-driven risk-taking (“push harder”)
☐ Hesitation to challenge decisions

Indicators:

☐ Overcommitment to initial plan
☐ Ignoring warning signs
☐ Lack of speaking up

Findings:

Cultural norms can increase **risk tolerance and delay corrective actions**. [Human Fact...June 2026 | PDF]

SECTION 10: DYNAMIC RISK ASSESSMENT (DRA)

Evaluate if risk was actively managed:

☐ Hazards continuously identified
☐ Risk vs. benefit evaluated
☐ Strategy adjusted as conditions changed
☐ Trigger points (time, fire conditions, structural integrity) used

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Breakdown Indicators:

☐ Static size-up only
☐ No reassessment of conditions
☐ Delay in defensive transition

Findings:

Dynamic risk assessment requires **continuous evaluation and adjustment**, not a one-time decision. [Human Fact...June 2026 | PDF]

SECTION 11: ERROR PATHWAY RECONSTRUCTION

Document sequence of contributing factors:

Example format:
Stress condition → Cognitive effect → Missed cue → Decision → Outcome

Incident Chain:

_____

_____

_____

SECTION 12: KEY MISSED OPPORTUNITIES

Identify points where outcome could have changed:

- Early indicators that were missed:
- Decision points that could have altered outcome:
- Communication moments where intervention was possible:

SECTION 13: RECOMMENDATIONS

Focus on system-level improvements:

☐ Training (stress exposure, decision-making)
☐ Communication protocols
☐ Command structure improvements
☐ Policy/SOP updates
☐ Cultural reinforcement (risk discipline, speaking up)

Specific Recommendations:

SECTION 14: LESSONS LEARNED

Summarize key takeaways:

- Human factors identified:
- Key vulnerabilities:
- Actions to prevent recurrence:

Appendix B – Checklist Version Only

Here is a **concise, checklist-only version** designed for **rapid on-scene or immediate post-incident use**.

🔥 Human Factors Quick Checklist

Fireground Post-Incident (Fatality / Injury / Near Miss)

✅ 1. ENVIRONMENT & CONDITIONS

☐ High heat / extreme conditions
☐ Low visibility (smoke/darkness)
☐ High noise (radios, alarms, apparatus)
☐ Rapidly changing conditions
☐ Time pressure
☐ Fatigue / long duration

✅ 2. SITUATIONAL AWARENESS

☐ Critical cues identified
☐ Changes in conditions recognized
☐ Size-up updated continuously

Indicators of breakdown: ☐ Tunnel vision
☐ Task fixation
☐ Missed hazards or changing conditions

✅ 3. COGNITIVE LOAD

☐ Crews able to track:

- ☐ Location
- ☐ Air supply
- ☐ Assignments
- ☐ Time

Indicators of overload: ☐ Confusion or disorientation
☐ Missed radio traffic
☐ Loss of task tracking

✅ 4. DECISION-MAKING

☐ Strategy matched conditions
☐ Ongoing reassessment occurred
☐ Risk vs. benefit evaluated

Indicators of breakdown: ☐ Continued unsafe tactics
☐ Delayed strategy change
☐ Assumptions not challenged

✅ 5. STRESS EFFECTS

☐ Controlled, adaptive behavior
☐ Awareness of changing conditions

Indicators: ☐ Urgency overriding safety
☐ Fixation on single task/threat
☐ Reduced flexibility or adaptability

✅ 6. COMMUNICATION

☐ Clear and concise radio traffic
☐ Closed-loop communication used
☐ Regular updates provided

Indicators of breakdown: ☐ Missed or ignored messages
☐ Lack of critical information sharing
☐ Confusing or incomplete transmissions

✅ 7. TEAM DYNAMICS

☐ Roles clearly defined
☐ Command presence maintained
☐ Crews coordinated actions

Indicators of breakdown: ☐ Freelancing
☐ Confusion over assignments
☐ Poor crew coordination

✅ 8. CULTURE / RISK PERCEPTION

☐ Risk balanced with benefit
☐ Tactical discipline maintained

Indicators: ☐ Pressure to continue offensive ops
☐ Reluctance to disengage
☐ Hesitation to speak up

✅ 9. DYNAMIC RISK ASSESSMENT

☐ Hazards continuously identified
☐ Risk vs. benefit reassessed
☐ Strategy adjusted as conditions changed

Indicators of breakdown: ☐ Static (one-time) size-up
☐ No adjustment to worsening conditions
☐ No clear trigger points

✅ 10. CRITICAL FAILURE POINTS

☐ Missed cues
☐ Decision errors
☐ Communication failures
☐ Coordination breakdowns

✅ 11. IMMEDIATE TAKEAWAYS

☐ Key contributing human factors identified
☐ Immediate corrective actions identified
☐ Training or policy implications noted

⚡ Quick Use Summary

Use this checklist to rapidly answer:

- **What was missed?**
- **What was misunderstood?**
- **What wasn't communicated?**
- **What wasn't adjusted in time?**

Appendix C – Supporting Training Slide Deck Contents

Here is a **ready-to-use training slide deck outline** tied directly to the guidelines, worksheets, and checklists. This training teaches how to use routine After Action Reviews to increase effectiveness and safety on the fireground and can also be used for Post-Incident Reviews for Fatality / Serious Injury events. You can copy this into PowerPoint, Google Slides, or an LMS platform.

🔥 **Training Slide Deck**

Human Factors on the Fireground

Routine After Action Review to Increase Effectiveness & Safety/Post-Incident Review for Fatality / Serious Injury

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Slide 1 – Title Slide

Human Factors on the Fireground
Post-Incident Review & Learning Framework

- Focus: Firefighter Safety & Survivability
- Based on Human Factors Analysis Principles

Slide 2 – Training Objectives

By the end of this training, you will:

- Identify key human factors in fireground incidents
- Apply a structured post-incident review checklist
- Recognize breakdowns in cognition, communication, and decision-making
- Improve operational safety and decision quality

Slide 3 – Why Human Factors Matter

- Most critical incidents involve **system interactions**, not a single failure
- Stress affects:
    - Situational awareness

    - Decision-making
    - Communication
- Human factors directly impact **LODDs, MAYDAYs, and injuries** [Human Fact...June 2026 | PDF]

Slide 4 – Fireground Reality

Firefighters operate in:

- High stress
- Time pressure
- Sensory overload
- Incomplete information

➡️ These conditions degrade performance if unmanaged [Human Fact...June 2026 | PDF]

Slide 5 – The Human Factors Framework

We analyze incidents through 6 key lenses:

1. Environment & stress
2. Situational awareness
3. Cognitive load
4. Decision-making
5. Communication
6. Team dynamics & culture

Slide 6 – Quick Checklist Overview

During post-incident review, ask:

- What was missed?
- What was misunderstood?

- What wasn't communicated?
- What wasn't adjusted in time?

Slide 7 – Environment & Stress

Key factors:

- Heat, smoke, noise
- Time pressure
- Fatigue

Impact:

- Reduced attention and awareness
- Increased error rates

Slide 8 – Situational Awareness

Three levels:

1. **Perception** – What did we see?
2. **Comprehension** – What did we think it meant?
3. **Projection** – What did we expect next?

Slide 9 – SA Breakdown Indicators

Watch for:

- Tunnel vision
- Task fixation
- Missed hazards
- Failure to update size-up

➡️ Stress narrows attention and limits awareness [Human Fact...June 2026 | PDF]

Slide 10 – Cognitive Load

Firefighters must track:

- Location
- Air supply
- Assignments
- Radio traffic

IC and Command Staff:

Manageable span of control

Sufficient command support

Reliable, timely information

Assess -> Communicate->Re-Assess

Problem:

- Working memory is limited and easily overloaded [Human Fact...June 2026 | PDF]

Slide 11 – Cognitive Overload Indicators

- Missed radio transmissions
- Confusion about assignments
- Loss of situational tracking

Slide 12 – Decision-Making Under Stress

Two modes:

- Fast, automatic (experience-based)
- Slow, analytical (best solution vs first viable action)

➡️ Under stress, we rely more on **fast decisions** [Human Fact...June 2026 | PDF]

Slide 13 – Decision Breakdown Indicators

- “Doing what we always do”
- Failure to reassess strategy
- Delayed switch to defensive operations

Slide 14 – Stress Response Effects

Stress can cause:

- Fixation
- Reduced flexibility
- Reactive behavior

➡️ Higher stress = lower cognitive performance [Human Fact...June 2026 | PDF]

Slide 15 – Communication

Effective communication requires:

- Clear, concise messages
- Closed-loop communication
- Regular updates

Slide 16 – Communication Failures

Look for:

- Missed or ignored messages
- Lack of detail
- Poor information sharing

➡️ Stress reduces verbal clarity and detail [Human Fact...June 2026 | PDF]

Slide 17 – Team Dynamics

Strong teams have:

- Clear roles
- Strong leadership
- Shared understanding

Slide 18 – Team Breakdown Indicators

- Freelancing
- Confusion over assignments
- Lack of coordination

Slide 19 – Culture & Risk

Organizational culture and identity-based systems shape behavior and performance.

Identity, pride, reputation, crew expectations, mindsets/behaviors informally reinforced

Fire service culture can influence:

- Risk tolerance
- Decision speed
- Willingness to speak up

Slide 20 – Cultural Risk Indicators

- Overcommitment to offensive ops
- Reluctance to disengage
- Hesitation to challenge decisions

➡️ Culture can increase risk acceptance [Human Fact...June 2026 | PDF]

Slide 21 – Dynamic Risk Assessment (DRA)

DRA requires:

- Continuous hazard identification

- Ongoing risk vs. benefit evaluation
- Strategy adjustments

Slide 22 – DRA Breakdown Indicators

- Static size-up
- No reassessment
- Delayed tactical change

➡️ Risk must be continuously managed [Human Fact...June 2026 | PDF]

Slide 23 – Error Chain Concept

Most incidents follow a pattern:

Stress → Cognitive effect → Missed cue → Decision → Outcome

➡️ Small failures combine into major events

Slide 24 – Applying the Worksheet

Use the worksheet to:

- Identify breakdowns
- Map the error chain
- Highlight missed opportunities

Slide 25 – Key Questions During Review

- What signals were missed?
- What decisions failed?
- Where did communication break down?
- When should strategy have changed?

Slide 26 – Lessons Learned

Focus on:

- Systems, not blame
- Patterns, not isolated errors
- Prevention, not hindsight criticism

Slide 27 – Improving Performance

Key improvements:

- Improved decision-making and safety
- Better communication discipline and team dynamics
- Continuous risk assessment and accurate situational awareness
- Stress-exposure training
- Encouraging speaking up

Slide 28 – Final Takeaways

- Human factors drive fireground outcomes
- Stress degrades performance in predictable ways
- Structured review improves safety and survivability

Slide 29 – Discussion / Scenario (Optional)

- Review a recent incident
- Apply checklist in small groups
- Identify human factor breakdowns

Slide 30 – Closing

Disciplined aggression = Maximum effectiveness + Controlled risk