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Can They Be Saved? Utilizing Civilian Survivability Profiling to Enhance Size-Up and Reduce Firefighter Fatalities in the Fire Department, City of New York

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed_____

Abstract

Over the past 19 years 32 firefighters in the Fire Department, City of New York (FDNY) have been killed in structural fires. Excluding the terrorist attacks of September 11, 2001, no civilians were killed in those same fires. This dichotomy triggered the research problem: FDNY firefighters being killed disproportionately compared with civilians during the same fires. Current mindset and traditional size-up techniques may unjustly put members at risk when there are no civilians to be saved. Through descriptive research the purpose was to reveal and examine this disparity and produce recommendations to reduce firefighter fatalities. The research answered the following questions: (1) What methods does the FDNY use to conduct size-up? (2) What is the attitude of firefighters regarding risk-versus-reward? (3) What methods are used to track firefighter and civilian fire fatalities nationally? (4) What FDNY methods track civilian fire fatalities? (5) What methods compare firefighter with civilian fire fatalities nationally? (6) What are the most recent national statistics comparing firefighters with civilian fire fatalities? (7) What is the survivability profiling? (8) What are the survivability limits for civilians during structural fires? And (9) How can survivability profiling enhance FDNY size-up techniques? After an extensive literature review, utilization of expert-specific interviews and questionnaires, and direct observations, the results concluded that: nationally over the past 2 years, 79 firefighters and 6 civilians were killed in the same fires, a safer risk-versus-reward cultural change is required, and finite survivability limits for civilians must be realized. Recommendations included: to update FDNY size-up techniques that reflect prioritization of firefighter's lives to reword the existing "aggressive interior attack" strategy, to provide cultural change training in an attempt to alter the belief that dying is integral part of firefighting, and to further define survivability profiling into measurable and reliable procedures.

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Introduction

Firefighters are sworn to protect life and property. Of those priorities, life takes precedence above all else and "that should include the lives of firefighters" (Hay, 2007a, p. 1). Since 1978 the national average of firefighter fatalities has held steady at approximately 100 annually (United States Fire Administration, 2002) with 118 occurring in 2008 (National Fallen Firefighters Foundation, 2009). Civilian fire deaths in 2008 totaled 3,320 (Karter, 2009).

What is not represented in these statistics is a comparison of civilian fatalities versus that of firefighters. The research problem is that firefighters in the Fire Department of New York City (FDNY) are continuously being killed during structural fires in disproportionate numbers compared with civilians in the same incidents. The current mindset and traditional size-up criteriea utilized by the department may unnecessarily put members at risk when there are no civilian lives to be saved.

Comparing these statistics may be useful in helping to save firefighters' lives. Therefore, the purpose of this research is to produce recommendations that may reduce firefighter fatalities in the FDNY. By comparing firefighter and civilian fire fatalities during the same structural incidents, this research will help reveal the apparent disparity and develop new size-up strategies and/or viewpoints that the FDNY may adopt to assist in achieving that purpose.

To that end, this project will utilize descriptive research to help answer the following questions:

1. What current method does the FDNY use to conduct size-up?
2. What is the general attitude of firefighters regarding risk-versus-reward and the saving of lives during structural fires?
3. What methods are used nationally to track firefighter and civilian fire fatalities?

4. What methods does the FDNY use to track civilian fire fatalities?
5. What methods do the FDNY and other agencies throughout the nation use to compare firefighter with civilian fatalities in the same incidents?
6. What are the most recent New York City and national statistics regarding firefighter fatalities during structural fires, and how do they compare with civilian fatalities in the same incidents?
7. What is the concept of "survivability profiling"?
8. What are the survivability limits for civilians during structural fires?
9. How can the FDNY civilian survivability profiling to enhance size-up considerations?

The descriptive research method will also assist in assessing any disparity between firefighter and civilian fatalities occurring in the same incidents. Person interviews, questionnaires, direct observation, and historical documentation will examine the current size-up criteria employed by the FDNY. Additionally, the research approach will look at the attitudes of FDNY incident commanders, fire officers, and the firefighters who apply to the current size-up techniques. By defining present circumstances, this research will set out to enhance the current FDNY size-up procedures and will provide recommendations for alternative strategies that may assist in saving firefighters' lives.

Background and Significance

According to the its Vital Statistics Report (Fire Department, City of New York, 2009a), the FDNY, in its 145th year, consists of 14,446 fire officers, firefighters, emergency medical technicians, paramedics, fire marshals and fire inspectors. These highly trained individuals are supported by 1,640 dispatchers, civilian support and trade personnel. Working together, the FDNY protects the lives and property of over eight and one-half million residents and four

million daily travelers who visit the city's 322 square miles for work, vacation, and entertainment (NYC & Company, 2006-2009).

The mission of the FDNY is to: "Fight Fires, Save Lives and Minimize Property Damage, Provide Pre-Hospital Emergency Medical Services, Prepare for Terrorism, Investigate Cause and Origin of Fires, Enforce New York City (NYC) Public Safety Codes, and Conduct Fire Safety Presentations and Events" (Fire Department, City of New York, 2009b, p. 1).

From July 1, 2008 through June 30, 2009 (the FDNY's fiscal year 2009), the FDNY had 993,375 apparatus responses and extinguished 26,503 fires. The FDNY also responded to 193,709 non-fire emergencies and 1,879,680 medical emergencies (Fire Department, City of New York, 2009a).

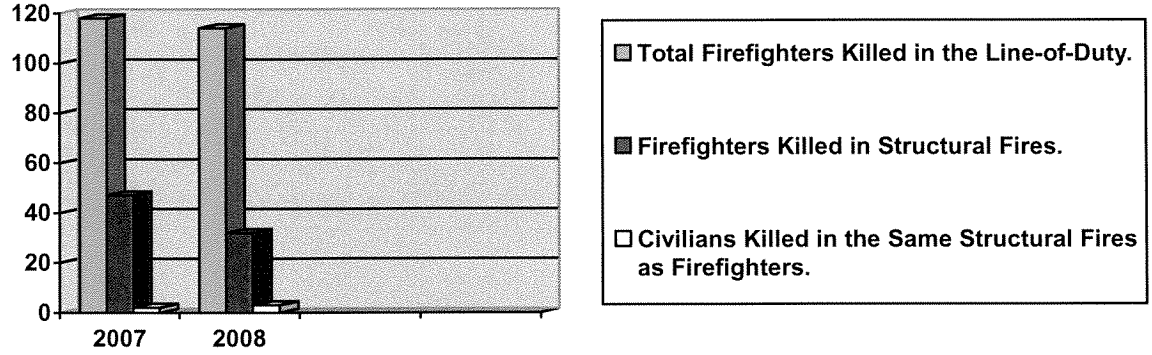
Since the formation of the department in 1865 the FDNY has suffered 1,141 firefighter line-of-duty deaths (Fire Department, City of New York, 2008a). Most recently, in 2008, the FDNY suffered two line-of-duty-deaths in separate incidents. In that same year the total number of civilian fire fatalities in the city was 86 (Fire Department, City of New York, 2008b). It should be noted that none of those civilian fatalities occurred in either of the fires where the two FDNY members were killed. In fact, over the last 19 years (excluding the 343 FDNY members killed in the terrorist attacks of September 11, 2001, and seven others who died due to other circumstances) there have been 32 firefighter line-of-duty-deaths at structural fires and *none* of those fires resulted in civilian fatalities. These statistics are what provided the springboard for this research—no civilian fatalities during the same fires where FDNY members were killed in nearly two decades.

As represented in Figure 1, the same apparent disparity between firefighter and civilian fatalities exists nationally—hence, the significance of this research on both a local and a more

global scale. For example, in 2007, out of the 118 firefighters killed in the line-of-duty, 47 were killed in structural fires, with only two civilians killed in those same fires (National Fallen Firefighters Foundation, 2008). Ironically, in 2008, another 118 firefighters were killed in the-line-of-duty, 32 in structural fires, with only four civilians being killed in those same fires (National Fallen Firefighters Foundation, 2009)

Figure 1

U.S. Firefighter Versus Civilian Fire Fatalities in Structural Fires



In the fire service today, with rapid intervention teams (RIT) being the norm—that is, "a fire company trained, equipped, and so designated, whose sole mission is to search for and rescue trapped or lost firefighters" (New York State Office of Fire Prevention and Control, 2004, p. 951) and in spite of all of our technological advances, national firefighter fatalities are not decreasing and as previously presented, have accounted for approximately 100 firefighter deaths annually since 1978 (United States Fire Administration, 2002). A realistic approach to risk-versus-reward analysis and *survivability profiling* are commensurate and complementary to each other. Survivability profiling—as being introduced in this research—is the art of making decisions based on known events or circumstances, to determine if civilians can survive and be saved inside burning structures (S. Marsar, personal communication, February 12, 2009).

Perhaps the fire service must acknowledge that in some instances, the reasonable time frame of survival for the occupants may have passed and the rescue operations that firefighters would normally perform may now have turned to a recovery operation. Rescue operations are defined as "those actions that firefighters perform at emergency scenes to remove victims from imminent danger or to extricate them if they are already entrapped" (New York State Office of Fire Prevention and Control, 2004, p. 952). A recovery operation is commonly referred to in the emergency services as the non-emergent retrieval of human remains after the prognosis or assumption of death (S. Marsar, personal communication, July 7, 2009).

The fire service at large and FDNY in particular may need to recognize and accept this reality when it presents itself before firefighters are committed to search and rescue operations. The term search and rescue operations is defined as "attempts by fire and emergency service personnel to coordinate and implement a search for missing persons and then effect rescue" (New York State Office of Fire Prevention and Control, 2004, p. 951). The necessity for such a change in outlook is demonstrated in the *National Fire Codes* as approved by the National Fire Protection Association's (NFPA) standard on Fire Department Occupational Safety and Health Program (National Fire Protection Association, 2007) commonly known as NFPA 1500. This consensus national standard has been revised and published in 1992, 1997, and 2002, respectively. The fifth and latest edition of NFPA 1500 was approved on August 17, 2006. Section 8.3.2 of this edition states:

> (1) Activities that present a significant risk to the safety of members shall be limited to situations where there is a potential to save endangered lives. (2) Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of members, and actions shall be taken to reduce or avoid these risks. (3) No risk to the

> safety of members shall be acceptable when there is no possibility to save lives or property. (4) In situations where the risk to fire department members is excessive, activities shall be limited to defensive operations. (p. 1500-23)

In *Annex A* of that same document (section A.8.3.2), the rules of engagement for risk management to be considered by fire departments is shortened and states:

> (1) We will risk our lives a lot, in a calculated manner, to save SAVABLE LIVES. (2) We will risk our lives a LITTLE, in a calculated manner, to save SAVABLE property. (3) We WILL NOT risk our lives at all for a building or lives that are already lost. (p. 1500-45)

The National Fire Academy (NFA) has adopted a more succinct risk-versus-reward analysis model based on NFPA 1500. It utilized and discussed throughout many on-campus course curricula as: "risk a lot to save a lot, risk a little to save a little, risk nothing to save nothing" (Peterson, 2005, p. 3) This mantra from the NFA has also been adopted by several fire departments in their standard operating procedures such as Louisville, KY which requires each member to carry a laminated business-size pocket card while on duty stating: "We accept great personal risk to save another person's life. We accept moderate risk to save another person's property. We accept no personal risk to save what is already lost" (C. Haueter, personal communication, July 7, 2009). Likewise, the Phoenix, AZ fire department has adopted the NFPA's Annex A, section A.8.3.2 verbatim as part of its standard operating procedure entitled Safety and Risk Management Profile (Phoenix Fire Department, 2001, p. 1).

Deputy Chief LeDuc (2009) of the Broward County Sheriff Fire Rescue, Fort Lauderdale, FL points out "don't mistake risk for chance!" (p. 8) LeDuc acknowledges that incident commanders may take acceptable risks, especially when trapped occupants or firefighters are at

stake. However, “to forgo risk assessment [and survivability profiling] and leave the results to change…would raise the big red flag of unacceptable risk” (p.8).

Perhaps no one knows this better than District Chief Mike McNamee of the Worcester, MA Fire Department who, on the night of December 3, 1999, courageously made the decision to stop firefighters from entering a large, stubborn fire in a cold-storage warehouse and search the building that had already claimed (at that time) the lives of four firefighters. A cold-storage warehouse is defined as “a mostly windowless, extremely well insulated and climate controlled building used to store perishable items and temperature/humidity sensitive articles” (Seaboard Warehouse Terminals, 2009). Although two additional firefighters were ultimately lost during that tragic fire, the risk assessment performed by Chief McNamee is credited with the saving the lives of at least a dozen more. The chief utilized *survivability profiling* in the harshest sense. He knew that, after losing radio contact with the lost firefighters who were out of air for over 15 minutes in a windowless and fully engulfed building, they were beyond rescue. He boldly decided to cut the department’s losses and not risk the lives of the remaining firefighters who were so bravely ready and willing to go back inside and search for their missing brethren.

Understandably, members of the fire and emergency services give fire victims and medical emergency patients the benefit of the doubt. Battalion Chief Stephen Raynis, commander of the FDNY’s Safety and Inspectional Services, points out, “firefighters aggressively search for and rescue fire victims while relying on their training and personal protective equipment for safety” (Raynis, 2009, Introduction), and FDNY Chief of Department Salvatore Cassano adds: “Hundreds of fire victims are saved every year due to our notion that someone could *possibly* be trapped” (S. Cassano, personal communication, August 24, 2009).

It has been well documented in the media and throughout fire department history and lore that the firefighter's perception of probable life hazard (based on accepted size-up techniques) has led firefighters to "deeds of great daring, even at the supreme sacrifice to save live" (E. Croker, *circa* 1910). Conversely, less documented is the fact that this automatic assumption as to possible and even probable life hazards has also led to firefighter fatalities in structures where no civilian life hazard existed (S. Marsar, personal communication, July 27, 2009).

In the introduction of the FDNY's *Safety Week Initiative Booklet*, Raynis (2009) proposes that "Firefighters generally have a high level of risk acceptance" (introduction, para. 1). He states that with today's protective clothing ensembles, firefighters expose themselves to greater dangers than our predecessors did. Raynis continues that due to our "protective envelope" (para. 1) there is a belief that we can do our jobs better and safer. However, he cautions, the risks have actually increased. "The only way to really affect firefighter deaths and injuries is by modifying how we work together…Safety must be the first thought, all other decisions and operations should revolve around the safety of our members" (para. 2). Raynis concludes his introduction by writing:

> All members must realize that we must never accept any risk which is considered unnecessary or outweighs the expected reward of the act. However, our mission in the FDNY is to save lives, and high risk endeavors may be undertaken when there is clear knowledge that the sum of the benefit exceeds the sum of the risk to human life. Everyone must understand that operational risk management is about controlling risk, not avoiding taking risks at all. (para. 5)

Raynis echoes the sentiments of the NFPA 1500 and National Fire Academy's risk-versus-reward model. The notion that size-up responsibility (risk-versus-reward) is the responsibility of each individual firefighter, not just fire officers is also championed by Peterson (2005).

Additionally, as an after-action investigator of firefighter line-of-duty-deaths, Smith (2006) contends: "Front-line firefighters will go into hell if they are allowed…Too often, brave but misguided troops head into an ambush that needs to be stopped by the responsible commander" (p. 114). He further asserts that although this activity may be justified by the premise of search and rescue, the missing piece of the puzzle is that human skin fails at 124 degrees Fahrenheit and oxygen deficient environments can cause the deaths of civilians and/or unprotected firefighters in just a few breaths. He continues, "Fireground disasters are not acts of God nor are they unpreventable" (p. 114).

If firefighter fatalities are preventable, especially when looking at the proposed disparity between civilian and firefighter structural fire deaths, then it can be said, in the words of the poet and philosopher George Santayana: "Those who cannot remember the past are condemned to repeat it" (Santayana, 1905, p. 284). Edward Fletcher, a National Fire Academy instructor, relates that sentiment to the emergency services by further alliterating: "If a firefighter's fatality is predictable, then it's preventable; and if it's preventable, then it wasn't an accident" (E. Fletcher, personal communication, January 8, 2008).

Regarding the repeat of history and the fire service, Sendelbach (2009a) in his article "Blinded by Success" states: "We've come to characterize fireground success as an aggressive wall-to-wall search [for life] supported by an interior attack and effectively coordinated ventilation" (p. 12). An interior attack is defined by Dunn (2008) as when all of the following occur: (a) firefighters enter a burning building and search for trapped victims without the

protection of a hoseline, (b) firefighters enter the fire area to search for the location of the fire before a protective hoseline is in position to extinguish the fire, (c) firefighters advance hoselines beyond the doorway of the fire area, and (d) firefighters operate in the areas above the fire to search for life, fire extension and to ventilate. Ventilation is defined as "the removal of heat, smoke, and toxic gases from the room or occupancy on fire" (New York State Office Of Fire Prevention and Control, 2004, p. 955). Sendelbach (2009a) notes that a casual observer from outside the fire service might recognize a "strategic or tactical flaw" (p. 12) in the traditional firefighting operations, given that a slight change in any one of a multitude of possibilities (such as fire behavior, structural compromise, wind, or water loss) could have a dramatic and possibly disastrous effect on the win/loss record of the firefighting crews. In a related article, "Time to Go," by Jakubowski (2009), the author asks:

> What's the difference between walking away a winner and not walking away at all? Sometimes it's just luck. Sometimes it's good people intensely focused on their job and the environment they're working in…As firefighters we must focus our attention on the elements we can affect. (p. 32)

While discussing firefighter focus and tunnel vision, which is defined as "the focus of attention on a particular problem [or task] without proper regard for possible consequences or alternative approaches" (New York State Office of Fire Prevention and Control, 2004, p. 955), Jakubowski (2009) states that fire officers "must do a better job of preparing our personnel to understand when it's time to back out and switch to defensive operations" (p. 32). A defensive operation is defined as "a calculated attack on part of a problem or situation in an effort to hold ground until sufficient resources are available to convert to an offensive form of attack" (New York State Office of Fire Prevention and Control, 2004, p. 941). On the other hand, an offensive operation is

defined as “an aggressive attack on a situation where resources are adequate and capable of handling the situation” (New York State Office of Fire Prevention and Control, 2004, p. 949). Sendelbach (2009a) concurring with Jakubowski (2009) completes his article by saying:

> Our focus cannot be blinded by our past successes or our relentless desire to win. Some battles present insurmountable challenges beyond our physical…control. The true strength of the modern fire service…is our ability to adapt to the changing circumstances in a manner that produces the most effective outcome. (p. 12)

To illustrate, in a most dramatic example, where *survivability profiling* may have been applied to size-up and help avert tragic firefighter deaths, the following story is offered: On December 22, 1999, at 8:24 a.m., the four available career firefighters of the Keokuk, IA Fire Department arrived at the scene of a confirmed house fire. A woman standing on the front lawn was covered in soot and yelling, “My babies are inside!” Apparently, the plastic trays from her 22-month-old twins’ high chairs were left on the stove, and their four-year-old brother turned on a burner. After confirming that the woman (who had escaped with her four-year-old son) was indeed referring to her remaining three children, the firefighters entered the home and recovered the lifeless twins (who were never revived). After reentering the home and while attempting to exit with the third unconscious child (a seven year old) in arms of one of the firefighters, a flashover occurred—instantly killing the three firefighters. A flashover is “a sudden event that occurs when all the contents of a container [or area] reach their ignition temperature simultaneously” (New York State Office of Fire Prevention and Control, 2004, p. 944). Ignition temperature is defined as “the temperature of a liquid at which it will ignite on its own [and continue to burn] without an ignition source” (New York State Office of Fire Prevention and Control, 2004, p. 946). Autopsies of the three children revealed that they died of smoke inhalation. “Even in that

situation, despite their instincts to save lives, the firefighters should not have gone into that house; [according to the medical examiner] the children were probably already dead," said the fire chief, Mark Wessel (Dedman, 2005, p. 4).

The official report of the Keokuk fire as investigated by the National Fire Protection Association (2000) found contributing factors in the firefighter fatalities to be (in this order): (a) lack of proper building/incident size-up (risk-versus-reward [and survivability profiling]), (b) lack of proper incident command structure, (c) lack of an accountability system, (d) insufficient resources to mount simultaneous suppression and rescue activities, (e) lack of a rapid intervention team (RIT), and a lack of standard operating procedures requiring a RIT. As Chief Wessel added: "Did they [the firefighters] do what any red-blooded American firefighter would do? Yes, they did." (Dedmand, 2005, p. 2) The lessons learned that day according to Wessel, were "what you need to do is slow down your operations. We should have focused more on the hose, less on the mother screaming" (Dedman, 2005, p. 3).

Utilizing *survivability profiling*, the firefighters in Keokuk may have realized what their fire chief and the NFPA report suggests—due to the amount and volume of smoke, the advanced stage of the fire upon arrival, and the limited resources to conduct both the fire attack and search and rescue, the victims' survivability was extremely unlikely (Dedman, 2005, p. 3).

To that end, the significance of this research is to positively impact the reduction of firefighter fatalities during structural fires both in the FDNY and throughout the national fire service. That impact coincides with the United States Fire Administration's (USFA) mission to "saving *[sic]* lives and reduce economic loss due to fire and related emergencies" (United States Fire Administration, 2005, p. iii) as well as the USFA strategic plan, Goal 1, Objective 1.1, which states: "Encourage the state, local, and tribal adoption of risk reduction, prevention,

mitigation, and safety strategies" (United States Fire Administration, 2009a, p. 15). Additionally, this research directly relates to the National Fire Academy's Executive Leadership Course's Unit 4—Developing Decision Making Skills—by providing additional information and considerations to assist the executive fire-leader in answering question number two of the "diagnostic questions for decision making," namely: "Does the leader have sufficient information to make a quality decision?" (United States Fire Administration, 2005, p. SM 4-3). This research also meets the NFA Executive Leadership (R125) course goal that: "The chief fire executive will develop the ability to conceptualize and employ the key processes used by effective executive-level managers" (United States Fire Administration, 2005, p. v).

As presented by this research, FDNY fire officers and firefighters may be able to analyze and apply *survivability profiling* as a new size-up strategy during structural fires to help reduce firefighter fatalities.

Literature Review

The need to reduce firefighter fatalities has been well established and documented in recent US fire service literature. Halton (2008) writes, "We really have come a long way in the area of firefighter safety and survival" (p. 10). He points to the tremendous strides that the fire service has taken to improve the health and welfare of firefighters, while accomplishing the impressive task of consistently lowering the civilian death rate and providing the "world's best firefighting operations" (p. 10). Over the last 30 years, when accurate and verifiable records were first kept, civilian fire death rates have been reduced 50 % to approximately 4,000 a year (Halton, 2008).

During this same 30-year period, Morris (2009a) reveals that nationally, the fire service has witnessed a 58% reduction in firefighter line-of-duty-deaths. However, he points out that we

have also seen a parallel drop of 54% in the total number of structural fires. With a redundant average of 100 to 110 firefighter fatalities a year, Morris asks: “Have we really made a difference with all these improvements or is a significant cultural change needed?” (p. 86) Similarly, in the retrospective study entitled Firefighter Fatalities in the US—2006 and What’s Changed Over The Past 30 Years? Fahy, LeBlanc, and Molis (2007), as part of the NFPA’s analysis and research division, attempt to answer the question: “To what degree has the decrease in firefighter deaths been driven by the drop in the number of structure fires?” (p. 3) Citing the declining trend since 1976 in both structural firefighter deaths and structural fires, and the fact that the declining trends of both track fairly closely, this is a good indication that the drop in firefighters deaths might have been, to a great extent, a direct result of the reduction in the actual numbers of structural fires (National Fire Protection Association, 2000).

This, according to Fahy et al. (2007), leads to a second question: “Are firefighters just as likely to die at structural fires today as they did 25 or 30 years ago?” (p. 3) Fahy et al. explain that the overall *rate* of firefighter deaths at structural fires has actually decreased by one-third as the decline in structure fires has plateaued (p. 4). Fahy et al. caution that despite improvements in personal protective equipment, training, and fireground command and control over the past three decades, specific injuries such as burns, smoke inhalation, and crushing trauma at structural fires have shown a marked increase.

Halton (2008) states the fire service is doing a much better job at keeping firefighters safer through improvements and standards regarding tools, technology, emergency vehicle operations and design, and Bunker gear (the slang term used to describe the fire retardant coat, pants, hood, helmet and gloves of a firefighter’s personal protective equipment ensemble [New York State Office of Fire Prevention and Control, 2004, p. 939]). But tragically, we are not

reducing the number of firefighter fatalities inside structure fires—especially in light of the fact that the number of structure fires has been decreasing (Halton, 2008). According to the National Fallen Firefighters Foundation (NFFF), “firefighters are doing a better job of preventing civilian deaths than they are at protecting their own lives” (Markley, 2009, p. 96).

Echoing that sentiment, Wood (2008) reflects that firefighter injuries in the United Kingdom (UK) have fallen by more than 40% since 2003. However, he cautions, “as the number of fire incidents has declined, the actual number of firefighter injuries in primary [structural] fires in fact may not have seen a comparable reduction” (p. 50).

It would appear from the vantage points of Halton (2008) and Wood (2008) that the issue of firefighter fatalities is systemic to the fire service locally, nationally, and even internationally based upon the inherent dangers of the profession. In relating firefighter fatalities to strictly structural firefighting operations and excluding all other causes, Grimwood (2008) points out that “for every 100,000 structural fires from 2004-2007 the UK suffered 1.9 firefighter fatalities where the US suffered 2.7” (p. 1). In contrast, the average number of firefighter fatalities in China per 100,000 fires equals 0.4 during those same years (S. Lo, 2009).

Karter (2008) adds that “in 2007 the UK suffered 485 civilian fatalities, the lowest since 1959, while the civilian fire fatalities in the US for 2007 total 3,430” (p. 1).

Another interesting contrast between the UK and the US is presented by Marinucci (2009) where he describes a recent video showing outraged UK firefighters protesting because of a spike in firefighter fatalities. According to his report, there were eight line-of-duty deaths in the UK during 2007, and a total of 13 between 2003 and 2007. However, no deaths occurred in the preceding seven years. The UK firefighters were demanding that something be done. Contrasting those statistics with the 118 US firefighter fatalities in 2007 (the same total as for 2008),

Marinucci (2009) suggests that the firefighting culture in the UK is less tolerable of line-of-duty deaths and that they find it difficult to accept even on national firefighter fatality. He continues, "The challenge for US firefighters is to develop a culture and attitude that do not accept line-of-duty-deaths as part of the job so it can use viable and workable solutions" (p. 115).

To shed light on fire fatalities in the US, beginning with the April 2009 issue, each month *Firehouse* magazine publishes a running total of firefighter line-of-duty fatalities and civilian fire fatalities with its editorial column—"As Firehouse Sees it." In the October 2009 issue, for example, it reports 75 line-of-duty firefighter deaths and 1,023 civilian residential fire fatalities year-to-date (Eisner, 2009a, p. 10).

In 2005 the *Boston Globe* newspaper examined the records of firefighter fatal fires across the nation and found that most died working in substandard conditions, arriving too late and with too few people, and going into buildings with no one inside to save (Dedman, 2005). The *Boston Globe* investigated the federal reports of 52 fires that killed 80 firefighters between 1997 and 2004. Each firefighter actually died fighting a building fire, not from heart attacks or motor vehicle accidents. Although the *Boston Globe* reported by Dedman includes contributing factors in the fatalities such as reduced firefighter staffing and inadequate response times, which fall far short of the NFPA's national response standards, for this research the more startling facts presented in the report are that:

> In only 14 of those 52 fires was there even a suspicion that someone might be inside. In only six of those 52 fires were people in the building at the time of the fire department's arrival, and, once again, <u>not</u> <u>one</u> of the 52 fires resulted in a civilian fatality. (p.4)

In an article entitled "Understanding Fireground LODDs: a Fresh Perspective on an Old Problem," Byrne (2007) laments that perhaps "the best way to remember those [firefighters] who

died I the line of duty is to make the cultural changes necessary to prevent future tragic deaths"(p. 100).

Byrne (2007) points to 75 structural firefighter fatalities that occurred between 1999 and 2004. He suggests that "although the fireground is an inherently dangerous place to work, it doesn't have to be deadly" (p. 102). Byrne also identifies five major contributing factors in firefighter fatalities as: (1) structural collapse, (2) firefighter disorientation, (3) emergency evacuation, (4) flashovers, and (5) entanglement (pp. 104, 106). He adds that in identifying these factors it is possible to work toward solutions to help correct action and save firefighters' lives. The article concludes that a cultural change must be made in the fire service and that change must begin "in the hearts and minds of firefighters, from chiefs to the recruit" (p. 106).

That same sense of cultural change is reiterated by Smith (2006) when he states: "We need to stop trying to perfect the way we kill our own…Firefighters will take themselves into infernos-if we allow it" (p. 116). He also writes that fire department commanders need to command and when they don't, they need to pay the price and be held accountable. According to Smith (2006), fire commanders must prepare themselves every day to protect their people. "If this person's actions are negligent from the standpoint of safe practices or prudent command decisions, then they should be removed" (p. 116).

Along these same lines of promoting a fire service cultural change, Markley (2009) states that fire service leaders must lead by example. It will take a significant amount of time and a continued drive to achieve cultural change, and fire service leaders must implement and enforce safety policies to effect the necessary change. Can we learn from other deadly industries? According to Markley we can: "If you work in the logging or any industry, there are

consequences for not following safety requirements…If firefighters are trained in the rules, told what the rules are and choose not to follow them, there must be consequences" (p. 96).

In an unprecedented initiate this cultural change, on March 10, 2004 the National Fallen Firefighters Foundation (NFFF) held the first-ever line-of-duty-death summit in Tampa, FL (Daniels, 2009). The NFFF identified over 225 key fire and emergency services stakeholders including fire service leaders, fire equipment manufacturers, national standards organizations, insurance entities, educational institutions, fire service book publishers, legal institutions, and investigative bodies, and invited them to attend. The summit was convened to determine how to reduce firefighter fatalities in the US and produce an agenda as a means to accomplish that (Burton, 2007).

As a result of the 2004 summit, the NFFF together with the United States Fire Administration (USFA) developed the "Everybody Goes Home Program." The program's objectives include reducing US firefighter fatalities by 25% within 5 years, and by 50% within 10 years (National Fallen Firefighters Foundation, 2004). The NFFF summit also adopted "16 Life Safety Initiatives" that must be addressed to reach these goals (see Appendix A).

In *FireRescue* magazine Sendelbach (2009b) acknowledges the 16 initiatives as a "tipping point" for the fire services. He relates the initiatives to the 1987 NFPA 1500 standard. When this standard was first adopted, the firefighters saw it as "the document that was going to ruin the fire service" (p. 12). It forbids the wearing of three-quarter-length rubber fire boots (which only covered firefighters' legs, not their torsos or pelvic area) in favor of Bunker gear, eliminated the option of firefighters riding on the outside of fire trucks, and mandated an accountability system for firefighters on the fireground. Sendelbach points out that after more than 10,000 public comments and over 20 years of interpretation, the NFPA 1500 has become

one of the most referenced documents in fire service history. It has saved countless firefighters' lives and has been useful in everything from budget and contract negotiations, to training standards, to purchasing fire apparatus, tools, and equipment.

Sendelbach (2009b) asserts that "the 16 Life Safety Initiatives were poised to be the next tipping point for the American fire service" (p. 12). He points out: "Goals were set, campaigns were launched, and educational materials were distributed. Yet five years later, statistic read much the same: approximately 100 line-of-duty-deaths annually" (p. 12).

The true tipping point, according to Sendelbach, must come from firefighters of all ranks taking ownership of their personal safety and "accepting responsibility—not as a matter of weakness, but rather an opportunity." He concludes: "The tipping point is within reach. It's our responsibility to stand strong, unite and make OUR safety PRIORITY No. 1!" (p. 12)

Further sentiment on the 16 initiatives can be found from Daniels (2009) where he presents a "report card" on these "ambitious and lofty goals" (p. 4). Five years following the National Fallen Firefighters Foundation's summit, he clarifies how successful the fire service has been:

> The average number of firefighter deaths in the five years following the summit is 98, it could be argued that there was a 20.7% reduction in line-of-duty-deaths. This reduction was 79.3% of the goal established by the U.S. Fire Administration [together with the National Fallen Firefighters Foundation]. (p. 4)

Used in a quantitative measure of success, the grad for the proposed reduction in line-of-duty-deaths five years post-summit would be a "C" and the resulting grade-point-average would be a 2.49% (Daniels, 2009). Therefore, Daniels questions if, as a national service, we should accept being just average when it comes to line-of-duty-deaths? Although the statistics he presented

reveal reasonable progress has been made, they may also conceal the "depth and difficulty associated with the actual achievement of the [*16 Initiative's*] goals" (p. 4).

Reacting to the feeling that the 16 Life Safety Initiatives are not getting through and that firefighters continue to die in unacceptable numbers, in March 2009 the National Fallen Firefighters Foundation (NFFF) reached out to the fire service magazines. In a conference call to the top four magazines, the NFFF asked if a combined effort could be made uniformly send the message of the *16 initiatives* out to the nation's firefighters (Eisner, 2009b). All four rose to the task and dedicated significant sections in their next issues to publicize the initiatives to the firefighting masses.

Still, not everyone goes home, write Goldfeder (2007), who insists that the elimination of death and injury in the firefighting profession is "not gonna happen" (p. 86). Likewise, Raynis (2009) writes: "The FDNY will never become error-free, injury-free, or fatality-free. What we need to concentrate on is developing a system to reduce the errors that we encounter at the fire scene" (introduction, para. 4). Furthermore, Halton (2009a) stresses that we as firefighters and fire officers must recognize "that we are always exposed to risks and are vulnerable, and that past successes is no indication of future safety" (p. 8). He also states: "We cannot eliminate all the risks…but…we must refocus our efforts to where they can do the most good and stop identifying the results of our problems on the fireground as the cause" (Halton, 2009 p. 8).

So why should we continue this call to action? Should our attitude really be everyone goes home? According to Goldfeder (2007), it is and it must. With this attitude, argues Goldfeder, "firefighters will continue to educate themselves and think of better ways to reduce needless firefighter injuries and deaths" (p. 86). Raynis (2009) challenges that "all of us

[firefighters] must make a concentrated effort to change the safety culture of the department" (introduction, para. 4).

As an example of his not everyone goes home theory and how some line-of-duty-deaths are unavoidable, Goldfeder (2007) cites the death of firefighter Kevin Apuzzio of the East Franklin, NJ fire department who was killed on April 11, 2006 while apparently doing everything right. Apuzzio was fully geared up in his personal protective fire equipment, he worked as part of a team, and the incident commander had accountability of them. When they arrived at the house fire there were good indications that the risk of entering the building was worth the reward: The husband of the victim was out front, screaming that his wife was trapped inside. What this research questions and will attempt to uncover as per the problem and purpose statement is, although this victim was known to be trapped, was her survivability *(profile)* predictable or likely, prior to attempting the rescue?

The International Association of Fire Chiefs (IAFC) Safety, Health and Survival section, much like the National Fallen Firefighters Foundation (NFFF), is dedicated to reducing line-of-duty-deaths and injuries. In 2008 the section moved to develop Rules of Engagement for Structural Firefighting (see Appendix B) to serve as a nationally developed model of procedures (Morris, 2009b). Derived from the highly successful rules of engagement in the use of deadly force in the law enforcement and military communities, these short, specific terms that are easily taught and remembered define critical rapid assessments necessary to prevent firefighter fatalities (Morris, 2009b). These rules were not meant to be in conflict with the previously established 16 Life Safety Initiatives of the Everyone Goes Home programs, but to augment those initiatives into standard operating guidelines that can be utilized on the fireground (Morris, 2009b).

As per Morris the objectives for the IAFC Rules of Engagement were to: (1) reduce the risk of firefighter fatalities and injuries, (2) define critical factors that place the firefighter at risk, (3) design a short bullet list that can be easily taught and remembered, (4) define go/no-go decisions that will keep firefighters safe, and (5) develop a lesson plan to provide proper training and explanation of the rules/bulleted lists. Early on in the development process the section realized the need for two separate lists, one for firefighters and one for incident commanders.

Morris (2009b) notes that although both Rules of Engagement contain similar bullets, "they are explained in the context of different levels of responsibilities at a fire" (p. 7). For the purposes of this project it is the four similar bullets that provide the most interesting research connection, namely: "Determine Victim Survival Profile," "DO NOT Risk Your Life for What Is Already Lost," "Extend Very CALCULATED Risk to Protect SAVABLE Lives," and "Extend LIMITED Risk to Protect SAVABLE Property" (Morris, 2009b, p. 6).

Propelling this research project forward is the IAFC's definition of just what victim survival profile is, Morris (2009b):

> To consider fire conditions and determine if any victims can survive the event as part of the initial and ongoing action plan development….No action plan can be accurately developed until we first determine if the victim can survive the existing fire conditions before rescuers reach them. (p. 6)

Morris writes that protecting firefighters from engaging in high-risk operations when all is lost (including victim survival and/or structural integrity), limiting risk exposure when trying to save structural property (keeping in mind that no building is worth the life of a firefighter), and managing search and rescue operations that are being performed in a calculated, controlled, and safe manner are the ultimate responsibility of the incident commander. Morris continues, "In

those cases the rescue effort must be fully supported with adequate fire suppression resources and close, continually assessing supervision" (2009b, p. 6).

In a conflicting opinion Halton (2009b) states that the National Fire Protection Association's NFPA 1500—Annex A (2007) and its fire department risk management rule, which reads: "We will risk our lives a lot, in a calculated manner, to save SAVABLE LIVES," is worded incorrectly. He believes that for firefighters to be true to what their communities expect from them and to be true to the "sacred honor of the firefighting profession" (p. 5), the phrase should read: "We will risk *everything* to save a savable life" (p. 5), and by everything he means even giving the firefighter's life. According to Halton, that's what is expected of us, "that is our sacred trust; that is what sacred honor means and that is why the fire truck is the greatest symbol of man's humanity to man" (p. 5).

Halton's opinion is contrary to the findings and results of this research and an apparent descent from the forward momentum of the USFA's Everybody Goes Home program (National Fallen Firefighters Foundation, 2004).

In summary, the literature review has influenced the research by providing a clear and detailed focus of the problem and purpose as stated, with the ultimate goal of utilizing the disparity between firefighter and civilian fatalities to help develop strategies and viewpoints that may assist in reducing firefighter fatalities.

Through the use of interviews and a questionnaire of FDNY incident commanders and staff chiefs (see Appendix C), this project examines the current FDNY size-up criteria and the broad mindset of its membership. The answers provided by these problem-area experts will continue to drive the remainder of this research. These specific individuals were selected due to their wealth of experience as incident commanders and their consistent use of size-up

procedures. Additionally, FDNY firefighters were interviewed to help present the mindset of first-line personnel and their attitude toward risk-versus-reward values.

The published documents referenced in the literature review have renewed the value of this research by advocating the need to reduce firefighter fatalities. Even though we have come a long way over the last three decades and despite the technological advances in firefighting gear and equipment (Halton, 2008), the critical findings of others reveal an ever-present and vast void for improvement. That void is particularly exposed when we examine that the statistical drop in firefighter fatalities parallels, in an almost mirror-like image, the drop in structural fires (Morris, 2009a).

As a profession, the US fire service must not accept the average 100 line-of-duty-deaths that occur annually (Daniels, 2009). We may need to adopt the attitude of our counterparts in the UK fire service where even one line-of-duty-death is cause of great concern and is unacceptable. Interestingly, although the UK line-of-duty-deaths have risen slightly per 100,000 structural fires in recent years, they are still far less than those in the US in the same number of structural fires over the last five years with none in the preceding seven year. During that same timeframe US firefighter fatalities have remained constant at approximately 100 annually.

The *Boston Globe* report (Dedman 2005) zeros in on this research's main goal, which is to clarify the disparity between firefighter and civilian fire deaths in the same incidents. Dedman (2005) cites 52 fatal fires where 80 firefighters were killed but not one civilian fatality occurred.

One item that the literature review did not provide was a concise definition of victim survivability profiling. Even though Morris (2009b) provides a general use of the term, as provided in the IAFC's Rules of Engagement (see Appendix B), defining this term will be a significant part of this project's original research.

A recurring theme found throughout the literature review is the need for a cultural change in the US fire service (Burton, 2007; Byrne, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis, 2009; Sendelbach, 2009a, 2009b; and Smith, 2006). The literature review found that the 16 Life Saving Initiatives (National Fire Protection Association, 2007) and the IAFC's Rules of Engagement for Structural Firefighting (Morris, 2009b) provide road maps for this necessary cultural change (Burton, 2007; Daniels, 2009; Morris, 2009a; National Fallen Firefighters Foundation, 2004; and Sendelbach, 2009b). They further prove that a cultural change will require buy-in from the US fire service. The necessity of this cultural change has served as a shot of adrenaline for this research. It has provided the impetus and a sturdy foundation on which to build definitive answers to the research questions.

Procedures

The procedures employed to prepare this Applied Research Project (ARP) consisted of developing a focused research problem, research purpose, and relevant research questions. A literature review was conducted in addition to a problem-area expert-specific questionnaire and personal interviews. Policies, procedures, and statistical records from outside emergency service agencies were used for comparison and contrast to those of the FDNY. The descriptive research method has been utilized to detail the past and present relationship between firefighter and civilian fire fatalities.

The first step of this ARP commenced on March 11, 2009, when the author contacted the National Fallen Firefighters Foundation (NFFF) to gather statistical information regarding firefighter fatalities. It should be noted that several organizations investigate and report on US national firefighter line-of-duty-deaths, such as : The National Institute for Occupational Safety

and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), and the National Fire Protection Association (NFPA). For this project, the researcher chose to utilize the NFFF's line-of-duty-death statistics, because they provide more expansive definitions and criteria, and include specific detail as to the cause of such fatalities. The ability to eliminate all causes of firefighter fatalities other than those occurring in structural fires allowed the researcher to stay focused on the problem and purpose statements and to answer the research questions.

Also on March 11, 2009, the USFA was contacted for information on the National Fire Incident Reporting System (NFIRS). This system, under the Federal Fire Prevention and Control Act of 1974, authorizes the USFA's national fire data center to gather and analyze information on the nation's fire problem (United States Fire Administration, 2008). The act further authorizes the USFA to develop uniform data-reporting methods, and to encourage and assist state agencies in developing and reporting fire and emergency data.

The NFIRS reporting format is consistent with the "National Fire Protection Association standard 901, Uniform Coding for Fire Protection" (United States Fire Administration, 2008, p. 1) and includes the full range of fire department activities as a true all-incident reporting system. According to the United States Fire Administration (2008), NFIRS represents "the world's largest, national, annual database of fire incidents" (p. 1). Although state participation in the program is voluntary, as of 2007 all 50 states and the District of Columbia report data into the system. Furthermore, over 21,000 fire departments report to the NFIRS each year, including 38 fire departments whose population served is over 500,000. This annual data allows NFIRS to record more than half of all reported fires that occur in the US (United States Fire Administration, 2008).

The contact name and information for each state's NFIRS program manager was acquired through the USFA's data collection manager on April 1, 2009. The inclusion of NFIRS and the analysis of what information is required to be reported has been collected with the intent of focusing the research around the disparity of firefighter versus civilian fire fatalities. It is hoped that the NFIRS information will provide proof of that disparity and help answer the research questions.

The researcher attended the Executive Fire Officer Program's Executive Leadership (EL) course at the National Fire Academy from May 18 to May 29, 2009. During the two weeks of the EL course, approximately 20 hours of research time was spent in the learning resource center on the academy campus to find documents, articles, past ARPs, and trade publications related to this subject for the literature review. A handwritten spreadsheet was developed to track important excerpts and to compare and contrast article information that was discovered and utilized throughout the literature review. This procedure also assisted in tracking the results of the research.

Upon completion of the EL course, a written ARP proposal was submitted on June 8, 2009. Guided by the evaluator's feedback and suggestions, the problem statement, purpose statement, and research questions were re written and more clearly defined. The ARP proposal was resubmitted to the evaluator on June 20, 2009, with approval being received on June 21, 2009.

The next step for this research consisted of drawing a "road map to success" (see Appendix E) to help develop an organized approach to the project. In addition, a completion check-off sheet was produced listing each required ARP section and proofreading confirmations. An approximate target date for the completion of each section was also included (see Appendix

F). The researcher decided that the required sections of the ARP would be completed in sequential order (with the exception of the abstract). Following the Road Map to Success (Appendix E), a master resource list (see Appendix G) and master reference list were established (the master reference list later became the ARP bibliography. A zealous effort was undertaken to identify emergency service organizations and individuals outside the FDNY to be contacted to assist in answering the research questions. These contacts were being sought as area-expert resources to validate the global aspect of the problem as presented within the research.

Concurrently throughout the months of March, April, May, and June 2009, each US fire department that suffered a firefighter line-of-duty-death in a structural fire during 2007 or 2008 was contacted to ascertain if any civilians were killed in the same fires. It should be pointed out that although some of the contact telephone numbers and/or addresses provided by the National Fallen Firefighter's Foundation (NFFF) were found to be incorrect, a diligent and persistence research effort obtained the correct contact information, and every fire department was successfully contacted. Several departments (especially the volunteer fire departments/fire companies) required leaving several messages and follow-up phone calls. The results of those contacts can be found in Appendix H.

Additional contacts within the FDNY were identified. A short questionnaire was developed and distributed to the FDNY contacts (Appendix C) to help determine if there is an issue with the current FDNY's size-up criteria and if the resulting attack plans of its incident commanders may need adjusting based on civilian survivability profiling. The initial contacts of individuals and agencies identified on the master resource list (both inside and outside the FDNY) were begun in July 2009.

On August 13, 2009 the researcher met with FDNY Chief of Department Salvatore Cassano at fire department headquarters. The interview was based on the research questionnaire (Appendix C), as well as the nine original research questions. Chief Cassano was most candid during the interview and provided specific insight into the research topic. Throughout July, August, and September 2009, additional FDNY interviews were performed via telephone and/or email with Chief of Safety Stephen Raynis, and Battalion Chiefs Mark Rosenbaum and Gerard Koziak.

The success of these interviews was due to advance planning and delivery of the research questions and questionnaire prior to the interview. This gave the chiefs ample time to formulate their answers and organize their ideas prior to the interview. Each interview was scheduled for approximately 15 minutes although most took substantially longer as the concept of survivability profiling was discussed. Approximately one week before the scheduled interviews a confirmation phone call or email was sent to each participant.

Additional interviews were performed throughout September and October 2009 as drill topics in several FDNY firehouses, including Engine Co. 8, Ladder Co. 2, Engine Co. 16, Ladder Co. 7, Engine Co. 21, Engine Co. 35, and Ladder Co. 14. The intent of these interactive drills was to gain the perspective of firefighters and fire officers concerning size-up and civilian survivability. The drills were based on some of the research results collected up to that time, as well as the FDNY questionnaire and nine original research questions. Members were asked their opinions on the research problem and purpose statements, and the use of civilian survival as part of their size-up considerations. Open discussion of the topic—where all viewpoints were welcomed and addressed—provided firefighters an open forum and a unique learning opportunity regarding the apparent disparity of firefighter versus civilian structural fire deaths.

The valuable input of these drill sessions will be used to help answer research question number two regarding the general attitude of firefighters concerning risk-versus-reward analysis and the saving of lives at structural fires.

Interviews outside of the FDNY were conducted either by telephone or via email with the contacts identified on the master source list (Appendix G). Outside contacts were purposely limited but represented a broad spectrum of fire departments of diverse size, region, populations served, and previous personal contacts with the researcher. Inclusion was also based on the necessity of follow-up information discovered during the research.

The extension of the literature review beyond the fire and emergency services proved advantageous to the research, particularly when attempting to apply scientific data to civilian fire survivability and the risk-versus-reward attitude of firefighters and fire officers. One limitation of outside sources included the lack of recent studies. It is important to note that the scientific study “Respiratory Burns: A Correlation of Clinical and Laboratory Results” (Corbitt, Given, Martin, Rhame, and Stone, 1967) has not been duplicated, or disputed since its publication. Although not as current as the related scientific report “Theoretical Evaluation of Burns to the Human Respiratory Tract Due to Inhalation of Hot Gas in the Early Sage of Fires” (Liu, Yong-Gang, and Zhang, 2005), it has been included in this research due to its scientific significance and relevance to the research topic, especially in answering research question number eight.

The outside perspectives—mostly scientifically based—validated the research purpose and will ultimately assist in answering research question number seven—defining the term survivability profiling (as introduced in this project). Furthermore, uncovered research concerning psychological do-or-die and intuition-based decision making, especially on the part of incident commanders, proved particularly relevant. Additional psychological factors that

affect many firefighters regarding saving lives at the risk of their own were also discovered, which helped to answer research question number two. Each of these factors tie into the strong cultural beliefs of firefighters and the possible necessity for a change in that cultural thinking (Burton, 2007; Byrne, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009a; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis, 2009; Sendelbach, 2009a; and Smith, 2006).

The Internet played a vital role throughout this research project. The Internet was used to elicit and respond to the questionnaire and interviews, and to clarify definitions. Several articles referenced in the literature review were retrieved via the Internet from the Learning Resource Center of the National Emergency Training Center (NETC) in Emmitsburg, MD as well as from the World-Wide-Web.

General limitations of this ARP included the unfortunate fact that, due to scheduling conflicts and logistical issues, more face-to-face interviews could not be conducted with incident commanders and firefighters to evaluate the realistic potential of survivability profiling. A secondary general limitation was the potentially large topic area and the necessity to concentrate on the less broad perspective. Keeping the problem and purpose of the research in focus was a key to overcoming this limitation. Additionally, it should be noted that a major malfunction (crash) of the researcher's computer resulted in the necessity of purchasing and setting up a new computer, resulting in a delay of almost three weeks. However, this setback provided the clear value of hand written documentation, hard-copy printing of the report as it progressed, and the backing up of all information to a reliable outside source rather than total reliance on electronic hardware.

The final stages in completing this ARP (September-October 2009) included compiling the materials, organizing the processes involved, and writing the report. The formatting, typing, and proofreading of the paper and the ultimate submission of the completed research to the NFA were accomplished prior to the submission date.

Throughout the literature review and research procedures three common threads consistently emerged: (1) calling for a cultural change within the U.S. fire service (Burton, 2007; Byrne, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009a; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis, 2009; Sendelbach, 2009a; Smith, 2006), (2) the need to reduce the number of US firefighter fatalities (Burton, 2007; Daniels, 2009; Morris, 2009a; National Fallen Firefighters Foundation, 2004; Sendelbach, 2009a), and (3) the apparent need to adjust current size-up techniques (Byrne, 2007; Markley, 2009; Morris, 2009a; Smith, 2006). These three common themes directly correlate to the problem, purpose and research questions of this applied research project.

Results

Halton (2009a) states: “There’s nothing more essential to protecting the lives of the citizens we swore to protect that is more important on the fireground than firefighter safety” (p. 8). The purpose of this research is to produce recommendations that may assist in reducing firefighter fatalities through new size-up strategies and/or viewpoints to bring about such an essential outcome. To that end, the following results of this project’s research are presented.

Research questions

1. What current method does the FDNY use to conduct size-up?

According to the FDNY’s (2009c) Firefighting Procedures, Ladder Company Operations: Tenements, section 1.6 (see Appendix D), size-up is:

> An ongoing evaluation of the problems confronted within a fire situation. Size-up starts with the receipt of alarm and continues until the fire is under control. This process may be carried out many times and by many different individuals during a fire. (p. 4)

This procedure provides 13 size-up factors (Appendix D) that all members must consider. These factors are taught to FDNY firefighters using the acronym *COAL WAS WEALTH* where each letter represents one of the 13 size-up factors, although not in priority order. Those factors are: (a) *Construction*. Fireproof versus non-fireproof, versus lightweight construction features, all of which present inherent problems unique to that particular type of construction and have an effect on fireground operations; (b) *Occupancy*. This determines the severity of the life hazard and the intensity of the fire; (c) *Area*. The building or occupancy boundaries that determine the type of search techniques to be utilized, the size of fire attack hoselines, and the expected intensity of smoke, heat, and flames; (d) *Life*. The most serious size-up factor at any fire. It includes the location of the fire and/or smoke in relation to the life hazard. The life hazard to firefighters must also be considered; (e) *Water supply*. The availability, location, and serviceability of hydrants and the readiness and placement of hoselines; (f) *Apparatus and equipment*. The consideration of what units are on scene and the arrival order and placement of such equipment; (g) *Street conditions*. This may affect response and apparatus placement at the fire; (h) *Weather*. Snow and freezing conditions, and wind velocity and direction are major safety concerns at fire operations; (i) *Exposures*. This could be adjoining buildings or areas within the fire building itself. Fire can travel from floor to floor via windows, up stairs and enclosed voids, and across shafts or adjoining apartments; (j) *Auxiliary appliances*, such as sprinkler systems and/or standpipe systems if present, as well as locations of shut-off valves and fire department connections. Sprinkler systems are “designed to automatically distribute water through sprinkler heads placed

at set intervals on a system of piping, usually in the ceiling area, to extinguish or control the spread of fire." Standpipe systems are defined as "piping systems that allow for manual application of water in large buildings from a location in proximity to the fire" (New York State Office of Fire Prevention and Control, 2004, p. 953); (k) *Location and extent of fire*. The location and severity of flames and their location within or outside of a structure. This will determine access routes for the fire attack and which areas will be searched first for life and fire extension; (l) *Time of the alarm*. Used to govern life hazard, nighttime fires in private or multiple dwellings are most serious due to the increased life hazard, than in the daytime; and (m) *Height*. Building height will govern the use of ladders, and the necessity to use fire service elevators or stairs.

These basic size-up techniques employed by the FDNY do not address the more advanced techniques that are taught and utilized by officers and incident commanders. However, as this research has discovered, members of all ranks need to develop and become cognizant of similar size-up criteria. As presented by Morris (2009a), several areas in the traditional firefighting culture regarding size-up could stand a change, such as teaching firefighters what will kill or hurt them, having clearly defined safety policies and procedures, and empowering all members to raise a red flag and to stop unsafe practices. He contends this will make a safer fireground for all.

Morris (2009a) also explains that fire crews generally view and receive orders in a top-down fashion. There is little two-way discussion, and subordinates have been trained to obey the order and do it, generally without question. The traditional culture makes it uncomfortable for firefighters to say no to unsafe orders, conditions, or practices. Morris further points out that the firefighting culture has not addressed how a firefighter, supervisor, or incident commander should manage such a situation if and when it is encountered. He states that by no means does he

feel that insubordination on the part of a firefighter should be tolerated—as fire scenes rarely allow for discussion or democratic voting. However, allowing members to voice concerns over safety issues mandates that the supervisor "accept the concern, take a few seconds to stop (assess), talk, and make a safe decision (go, no-go)" (p. 88).

Comparing the FDNY's 13 point size-up with the IAFC's Rules of Engagement for Structural Firefighting as shown in Appendix B (Morris 2009b), the first bullet in each of the lists—one for incident commanders and one for firefighters—might conceivably incorporate all of the FDNY's 13 basic size-up criteria. However, as this project examines, the major potential shortfall of the FDNY size-up list is the lack of evaluation concerning victim survival. The IAFC made this consideration the number two priority on each of the bullet lists for the rules of engagement. Under the FDNY criteria, "Life" limits the definition to the life hazard in relation to the fire and smoke and states the life hazard to firefighters should be "considered" (Fire Department, City of New York, 2009c, p. 4).

The FDNY size-up criteria for "Life," as written, does not take into account the likelihood of victim survival, but only the location of the life hazard. Likewise, the FDNY size-up criteria appears to inadequately prioritize the lives of the responding firefighters when it concludes "Life hazard to firefighters must also be considered" (p. 4). When compared with the NFFF's 16 Life Safety Initiatives (Appendix A), and the IAFC Rules of Engagement for Structural Firefighting (Morris, 2009b, [Appendix B]), which place the lives and safety of firefighters at the top of each list, the possible inadequacy of the FDNY policy is revealed.

2. What is the general attitude of firefighters regarding risk-versus-reward and saving lives during structural fires?

As a rule, “Firefighters are aggressive and risk takers by nature. But this does not mean they are suicidal” (Marinucci, 2009, p. 115). Utilizing several firehouse drill periods—which is a scheduled activity on each tour in each firehouse where officers and members train on various firefighting tools, techniques, theories and procedures (S. Marsar, personal communication, October 21, 2009)—firefighters in several FDNY firehouses were asked their opinions on the research topic, problem and purpose statements, and research questions (Engine Co. 16 and Ladder Co. 7, June 2009; Engine Co. 35 and Ladder Co. 14, July 2009; Engine Co. 21, July 2009; Engine Co. 8 and Ladder Co. 2, September 2009). It was discovered that the majority of firefighters value the lives of civilians above their own in most cases—particularly the younger and less experienced firefighters. These younger members appear to be more willing to take risks regarding life than their older, more experienced counterparts. Several younger firefighters voiced this as an automatic mechanism instilled in them by their training. The more senior members tend to favor a slower and more calculated approach based on their insight into past firefighter fatalities and the progression of a more advanced ability to follow their instincts based on past experiences.

These interactive drill periods also showed that the majority of firefighters felt that it was the responsibility of their officers and the incident commander to conduct size-up while they focus on their individual firefighting tasks. Additionally, the firefighters working in the predominantly multiple story building neighborhoods of Manhattan shared a skepticism as to the application of survivability profiling in such large structures. At the same time, these firefighters agreed it might be applied to smaller single or multiple family dwellings.

Generally speaking, ladder company firefighters acknowledge their tendency to apply size-up techniques more regularly than their engine company colleagues, because engine

company firefighters work as a team where ladder company firefighters work more independently.

As defined by the New York State Office of Fire Prevention and Control (2004, p. 942) engine companies are assigned "as a group, working in concert, to deliver water to the fire scene." These firefighters stretch supply lines and attack hoselines to extinguish fires. Supply lines are defined as "large hose [3½ inches in diameter or larger) [*sic*] used to move water from the water source to attack units" (New York State Office of Fire Prevention and Control, 2004, p. 953), and attack hoselines are defined as "handheld hoselines to supply nozzles or other applicators" (p. 938).

Conversely, ladder company firefighters are responsible for gaining access to the structure, finding the seat of the fire, facilitating the engine company's hoseline advance, and searching for trapped occupants on all sides (as well as above and below) the immediate fire area—simultaneously. Therefore, ladder company firefighters must work in hostile fire, smoke, and heat environments—more often than not without protection of hoselines. The very survival of ladder company firefighters and the successful completion of their assigned tasks inherently require them to apply size-up techniques on a more regular basis (Dunn, 2008).

Coinciding with the above firefighters' observations regarding attitudes toward size-up, risk-versus-reward analysis, and victim survivability profiling, the concept of intuition was brought up. Based on experience-level decision making, this research found several publications relating to the general principles of do-or-die decision making.

In the first such article entitled "Firefighter Duty to Die Syndrome" (FDTDS) by Crawford (2007), the author examines the relationship between the line-of-duty fatalities and the psychological factors that create a cultural belief that dying in the line-of-duty is part of the job.

The article also questions whether the current focus of follow-up investigations into firefighter line-of-duty fatalities and serious injuries is sufficient. Acknowledging that firefighting is inherently dangerous, Crawford admits that some firefighters will die despite every precaution, safe workplace practices and healthy lifestyle changes meant to minimize such risks. However, looking at the US average of 100 line-of-duty deaths annually, he feels the fire service must begin to look beyond the traditional explanations and practical recommendations.

Crawford enhances that thought by stating the fire service "must expand those discussions to more aptly include psychological components such as those found in the FDTDS" (p. 2). Without serious discussion as to why some fire department cultures, groups, or individuals believe that unnecessary risk and unsafe behaviors are an acceptable part of the occupation, "the fire service is missing the mark and possibly a chance to save the life of one or more of its own" (p. 2). In an attempt to introduce Crawford's FDTDS to the FDNY as a learning tool, Hay (2007b) distributed a summary of the FDTDS to all field units, along with excerpts from FDNY training and procedures manuals. Unfortunately, it wasn't given the attention that it may have deserved.

In introducing the FDTDS, Crawford (2007) identifies it as a "firefighter's behavior that reflects a sense of obligation and duty to unnecessarily risk personal and others' safety above what is appropriate or required" (p. 1). He shows that the problem of FDTDS comes when firefighters venture beyond safe limits and escape unhurt. This increases their belief that since the behavior did not result in an injury, it must have been acceptable. Crawford further examines how firefighters who undertake unsafe actions often rely on the ends to justify the means, and the dangers of their actions are irrelevant if a victim is rescued and the fire is extinguished, "even if performing the task in a safer manner would have produced the same result" (p. 2).

Sooner or later, according to Crawford, the end will not justify the means as when a firefighter is seriously injured or killed. “The odds of tragedy are increased by the syndrome’s snowballing effect” (p. 2). If a firefighter is allowed to perform dangerous actions without consequence or, worse, met with praise, the chances are increased that the behavior will be repeated until a negative result ultimately occurs (Crawford, 2007). The bottom line, as offered by Marinucci (2009): “The challenge for US firefighters is to develop a culture and attitude that do not accept line-of-duty deaths as part of the job so it can use viable and workable solutions” (p. 115).

Regarding the investigations into line-of-duty deaths, Crawford (2007) suggests that the mental developments that led to the firefighter to being in that tragic place at that tragic time should be the focus of reducing deaths, and “not a sidebar” (p. 1). Crawford notes that currently, national firefighter fatality investigations, discussions and recommendations focus on practical actions, policy, and procedures, and all but ignore the “cognitive processes leading up to and occurring during the line-of-duty incidents” (p. 1).

Relating firefighter size-up techniques and decision-making criteria to the non-emergency services, Breen (2000) on trusting instincts states: “One of the prime tools in rapid decision making is mental simulation—the ability to evaluate a course of action by imagining how it may unfold and may ultimately play out” (p. 295). According to Breen, when it comes to making decisions and intuition in business you must trust your instincts. Similarly, Campbell (2000) writes that intuition is a tool that we all have, and if nurtured, intuition and gut feelings can boost sales, close deals, and make better hiring decisions. Confidence in one’s intuitive abilities is especially important when a decision must be made under deadlines without necessary facts (Campbell, 2000).

In his book “Sources Of Power: How People Make Decisions,” Klein (1999), after a decade of following firefighters, military personnel, paramedics, doctors, nurses, and even chess champions in *blitz* games—defined as “a type of chess game where each side has significantly less time to make their moves [minutes] than in normal tournament time [hours]” (Wikipedia, 2009)—has scientifically documented how people make choices under severe time constraints, with limited information and constantly changing goals.

Intuition, says Klein, is the driving force behind the ability to make decisions. Fire commanders use the same tactic. Instead of weighing lots of options, they may instinctive decisions and then compare them with alternatives. Klein also found that once recognized, intuition can be developed and utilized to its fullest extent. While most decision-makers liken this to a “sixth sense” or “extrasensory perception” (ESP) (p. 37), Klein’s hypothesis suggests that it is just intuition based on a storehouse of experiences in the brain. Over time firefighters are able to subconsciously categorize fires according to how they should react to them. They create one mental catalog for fires that call for a search for life and rescue, and another for fires that require and interior or exterior attack. Then they race through their memories in a “hyperdrive” (p. 261) search to find a prototypical fire that resembles the fire they are facing. As soon as they recognize the right match, they swing into action (Klein, 1999).

In the business world, Breen (2000) sees corporations that teach decision-making skills by insisting that their employees generate large lists of options may actually be slowing down the decision-making process. Klein (1999) refers to this as “analysis by paralysis” (p. 259). Newer employees may need to follow such a course of action because they need a framework to help them think through given issues. However, to get them past the beginner stage organizations must “accelerate the growth of their experiences, so that they can rapidly accumulate the

memories and cues that will enable them to make faster, better decisions" (Breen, 2000, p. 294). Breen suggests "the more you know the faster you go" (p. 294) and therefore corporations offering newer employees mental simulations of problems that have occurred or may occur will help them develop rapid assessment skills. The faster an employee can compare different approaches and options, the faster they will be at solving problems. Senior employees, according to Breen, can move faster because they look at an issue, develop a plan, rapidly assess its feasibility based on past issues, and move on. They do not need to compare and contrast different approaches (Breen, 2000).

The same holds true in the fire and emergency services which rely on drills (as presented earlier), after-action critiques, and story telling to assist newer members to grow in the decision-making process, thus providing them with more stored cognitive information than they have in actual experience (Klein, 1999). Therefore, the insights are presented by Breen (2000) and Campbell (2000) for the business community are also applicable to firefighters in risk-versus-reward analysis and the decisive actions required to save lives during structural fires.

Klein (1999) describes a classic decision-making model where practitioners "identify options, compile and compare them, evaluate them, rate them, and then pick the option with the highest rating" (p. 4). With fire commanders, Klein concludes that time pressure simply doesn't allow for application of this classic model. Split-second decision-makers, according to Klein, are more likely to come up with one course of action (based on past experiences), and run through it mentally to look for flaws. If no flaws are found, they take decisive action. If they do find flaws, they come up with another possible course of action. However, they never compare the two options: "They simply don't have the time or the energy" (p. 14).

Klein calls this the Recognition Primed Decision (RPD) making model (pp. 24-25). In essence, fire commanders compare quickly (and often unconsciously) the situation they're in with information stored in their mind—as a pseudo file drawer, Rolodex, or catalog system. They can then recognize features that are analogous to, or different from, these earlier experiences. This allows fire commanders to form accurate mental models and intuitive courses of action. Because of this, experience is extremely important in the split-second decision-making process. If one does not have the experience to fall back, one is more likely to follow the traditional and more time-consuming decision-making, model-gathering data and options, and comparing them (Klein, 1999).

Klein emphasizes that when asking decision-makers how they did it, most answered that they simply drew from their experiences. However, he finds that experience is not a satisfactory answer. Revealing that battle-tested decision-makers are unable to explain how they make decisions, Klein states: "Their minds move so rapidly when they make high-pressure decisions, they can't articulate how they did it. They can see what's going on in front of them, but not behind them" (p. 90). Klein concluded that pressure-sensitive decision-makers, when confronted with a situation, often ask themselves, "what do I do," not "what's going on" (p. 127). Their experience buys them time—the ability to utilize size-up and to recognize the best course of action—rather than Extrasensory Perception (ESP).

Klein feels that fire commanders who withdraw their troops just before a sudden and catastrophic structural collapse simple use "SP"—the sensory perception that detected subtle differences in details compared with other fires in the commander's mind. Ultimately, according to Klein, "intuition is all about perception" and "the formal rules of decision making are almost incidental" (p. 93). He further believes that if everything works out okay, then fire commanders

stick with their choice. But, if they discover unintended consequences that could get them in trouble, they discard that solution and look for another. They might run through several choices, but they never compare one option with another. They rapidly evaluate each choice on its own merits, even if they cycle through several possibilities. Fire commanders don't need the best solution or plan; they just need one that works (Klein, 1999).

The interesting result on the attitude of firefighters regarding risk-versus-reward and saving lives is that the majority of firefighters felt that it is the responsibility of their officers and the incident commander to conduct size-up although the FDNY training material's introduction on size-up clearly states that "this process may be carried out many times and by many different individuals during a fire" (Fire Department, City of New York, 2009c, p. 4). This result is an affirmation and indication of a deficiency in the FDNY and the US fire service at large where a cultural change of attitude on the part of firefighters is required (Burton, 2007; Byrne, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009a; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis, 2009; Sendelbach, 2009a; Smith, 2006).

As discovered throughout this research, the prevalence in many fire service articles, literature, and texts is the perception that responsibility for size-up lies exclusively with fire officers and incident commanders, as demonstrated by Klaene and Sanders (2004) in an article on risk-versus-benefit analysis, where they state: "It's essential that company and chief officers are proficient in applying risk-versus-benefit principles" (p. 26). Those same sentiments were found throughout most of the literature review. However, some of the notable exceptions were Goldfeder, 2007; Jakubowski, 2009; Peterson, 2005; and Sendelbach, 2009a, who specifically address the need for all firefighters to remain situationally aware and responsible for their ultimate safety.

The results of this project point to the need for every firefighter on the fireground to be cognizant and to conduct size-up throughout every incident, particularly at structural fires, with specific concentration on the likely survivability of trapped occupants.

Another result of this research discovered during the drill-period conversations with firefighters found that, as introduced by Crawford (2007) in the Firefighter Duty To Die Syndrome (FDTDS), there is an underlying and palpable belief on the part of some firefighters that dying in the line-of-duty is, in fact, part of the job. This mindset coupled with traditional size-up criteria may unnecessarily put firefighters at risk when there are no civilian lives to be saved. This attitude in and of itself may preclude firefighters from applying survivability profiling until a cultural change occurs.

3. What methods are used nationally to track firefighter and civilian fire fatalities?

Several organizations investigate and report on US national firefighter line-of-duty deaths, such as: the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the National Fire Protection Association (NFPA), the United States Fire Administration (USFA), the National Fallen Firefighters Foundation (NFFF), and the National Fire Incident Reporting System (NFIRS). Similarly, more than one agency documents civilian fire fatalities: the NFPA, and the USFA. On the state and local levels, there are also many agencies that investigate and track civilian and firefighter fatalities. Local responsibilities are delineated to various fire and police departments having jurisdiction through fire marshal offices and/or police department arson investigators. The local fire agencies with investigative jurisdiction then report their statistics to their state's National Fire Incident Reporting System (NFIRS) program manager, who forwards those statistics to the USFA for inclusion in the annual NFIRS report.

This research found that the statistical analysis provided by each of these organizations is completed by statistical survey (USFA), consensus and mandatory standards (NIOSH), and census reporting (NFPA/NFIRS). The surprising result of this particular research question was that there is no current legal requirement that mandates reporting firefighter or civilian fire fatalities to these or any other statistical organizations. It was found, however, that a provision exists where participation in the NFIRS is required if a fire department is the recipient of a fire act grant for the period covering the assistance (United States Fire Administration, 2008). Fire act grants are monies approved by the US Congress as a directorate of, and administrated by, the Federal Emergency Management Agency in cooperation with the USFA to provide training, protective gear, and emergency vehicles, and to help increase the number of trained front-line fire personnel in individual communities. (United States Department of Homeland Security/Federal Emergency Management Agency, 2009).

As of April, 2009, all 50 states and the District of Columbia participate and report into the NFIRS (G. Kelch, USFA Fire Program Specialist, personal communication, April 1, 2009). Unfortunately, individual fire departments within each state are not required to participate except as noted above, although some states do require participation in their respective systems. These facts notwithstanding, over 25,000 fire departments do report into the NFIRS each year, an average of over 83% of all US fire departments. NFIRS also utilizes outside sources such as summary numbers for fires, deaths, injuries, and dollar losses from the NFPA, mortality data from the National Center for Health Statistics, and population data from the US Census Bureau (United States Fire Administration, 2008).

The NFIRS database comprises more than half of all reported fires that occur annually in the US according to the United States Fire Administration (2008). The current version of NFIRS

allows for a consistent single format for use at the national level reported by individual states, although each state is allowed to tailor their systems to meet specific needs. The current NFIRS version represents an all-hazard approach and captures all of the diverse incidents, not just fires, to which a fire department may respond (United States Fire Administration, 2008).

Casualty reporting of both firefighters and civilians—which is defined as fire-related death and injuries that occur within one year from the date of the incident (United States Fire Administration, 2008)—is part of the basic NFIRS data. However, not all fire departments that participate in NFIRS necessarily report firefighter casualties. Therefore, the USFA's annual firefighter fatality report statistics are collected separately from NFIRS. Some of the reasons for departments not providing this data may be: sensitivity by the department to the fallen firefighter's families, litigation and investigative concerns/issues, unknown outcomes of patient mortality or morbidity, insufficient follow-up information, and reporting deadlines as established by the United States Fire Administration (2008). Unfortunately, the latest fire-related firefighter injury report, which was released in February 2008, is based on 2004 NFIRS data. This report is not updated every year, but is currently on a three-year cycle (G. Kelch, USFA Fire Program Specialist, personal communication, March 30, 2009; November 4, 2009).

The NFPA generates its statistical information based on an annual sample survey of 30,000 fire departments listed in its US fire service inventory directory. Based on the desired level of statistical precision, in 2009 it was determined that 3,000 fire departments would be a reasonable sample for the year 2008. A sample size based on the two previous years' survey returns meant that 17,830 surveys would be necessary to obtain the desired 3,000 responses (Karter, 2009). Fire departments were placed into categories based upon the population size of the communities they protect. All fire departments of 50,000 or more were included. The

responding departments for 2008 totaled 2,846. National estimates are then developed using the fire service inventory and the US Census population data. The figures are estimated using a ratio-based estimation formula where the total for each particular statistic from all reporting fire departments is divided by the total population protected by the reporting fire department (United States Fire Administration, 2009b).

The National Fallen Firefighters Foundation (NFFF) collects it's firefighter fatality information from various sources such as: the NIOSH, the NFPA, the USFA, the International Association of Fire Fighters (IAFF), directly from fire departments that suffer a loss (M. Whitney, National Strategic Analysis Specialist, personal communication June 25, 2009), and from the US Public Safety Officer's Benefit Law (PSOB), which, according to the US Department of Justice (2009), was a law passed by the US Congress on September 29, 1976, as part of the Public Health Law 90-351, to assist in the recruitment and retention of federal, state, and local law enforcement officers and firefighters. The PSOB provides a one-time financial benefit to eligible survivors of law officers and firefighters killed as a "direct and proximate result of traumatic injury suffered in the line-of-duty" (US Department of Justice, 2009, introduction, para. 1, 2). It should be noted that the report published by the NFPA does not record or include firefighter line-of-duty fatalities. This report includes detailed statistical information regarding the number of fires, how the fires started, the damage they caused, the dollar amount of those losses, and the number of civilian fatalities and injuries only.

The NIOSH, under the auspices of the Center for Disease Control and Prevention (CDC), conducts investigations into firefighter line-of-duty-deaths and injuries as part of the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) (Baldwin et al., 2008). Based on concensus and mandatory standards, this organization formulates recommendations for

preventing future deaths and injuries (Morton, Olmstead, Peterson, and Witt, 2006). Over the FFFIPP's first five years, the reports generated several hundred recommendations. Although some of these recommendations overlapped or duplicated each other, a final list of 17 recommendations was selected to serve as sentinel recommendations to be sent to all 30,000 fire departments in the US. Subsequently, in 2008, after eight years, the program's report shared the most common recommendations from 335 investigations involving 372 firefighter fatalities and more than 1,286 recommendations that were developed by NIOSH investigators. Those recommendations included training, standard operating procedures, safety practices, and the safety environment of the fire departments, per Morton et al. (2006).

The NIOSH-FFFIPP does not enforce compliance with safety and health standards; that responsibility is reserved for the OSHA. Fire departments can use the document to develop, update, and implement policies, programs, and training for the prevention of firefighter injuries and fatalities. The NIOSH-FFFIPP does not determine fault or blame. It also does not track or report on civilian fire-related fatalities (Morton et al., 2006).

As this research discovered, several significant and detailed methods are used nationally to track firefighter and civilian fire fatalities. The significance of these reports is to shed light on the fire problem within the United States and to raise awareness as to the severity of that problem. Many of these reports, particularly those of the USFA and NFPA, document fire history and trends whereby the nation in general and the fire service in particular can reflect on the progress made in fire prevention and emergency mitigation. In addition, these reports allow the fire service to predict future needs and to identify, continue, and enhance fire prevention efforts.

4. What methods does the FDNY use to track civilian fire fatalities?

Prior to 2009, if there was a civilian fire-related fatality in New York City and FDNY deputy chief would conduct a fatal fire investigation and operations review following strict written procedures. The results of that investigation would be included in a detail report and forwarded to the chief of operations. The number of fire fatalities and circumstances surrounding the death(s) would then be recorded in statistical form for the city and forwarded to the New York Fire Incident Reporting System (NYFIRS), which in turn would become incorporated into the NFIRS by the USFA. There were no reports of civilians evacuated or rescued.

In February 2008, the FDNY formed the Performance Safety and Accountability Task Force. One of the important projects of this team was to establish a system of tracking the number of civilians evacuated, rescued or, saved during all fire department operations. In the spring of 2008, under a collaborative agreement, a team of graduate students from Columbia University started working on that project. Based on their findings, a committee of FNDY battalion chiefs and deputy chiefs volunteered to pursue what was now called the rescue/saved indicator (M. Manahan, personal communication, April 17, 2009). The committee developed definitions and procedures that could be incorporated into the existing FDNY incident data-gathering and reporting program. Over several months the FDNY-NYFIRS liaison worked with the state NYFIRS's consultant and program manager to refine the project.

In December 2008, the program began operation as an online pilot project. It is anticipated that in the fall of 2009, an additional indicator will be added to the reporting system to include civilians evacuated. These statistics were introduced within the updated FDNY Vital Statistics Report for the first time in July 2009 (Fire Department, City of New York, 2009a).

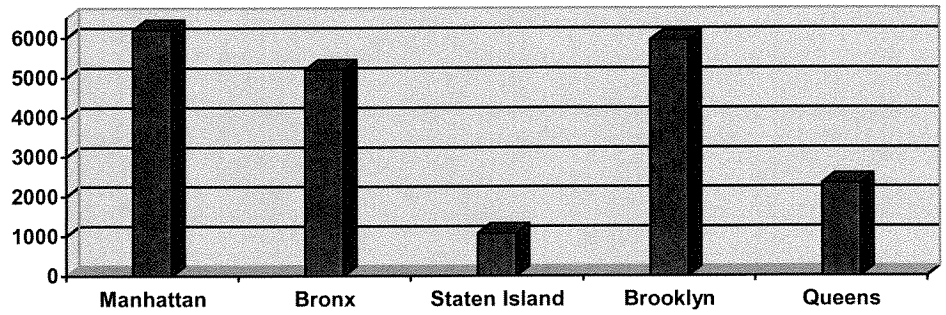
For the first time in the department's 145-year history, these results assist the FDNY in documenting the rescue work that its members perform on a daily basis. The final goal of this

endeavor is to work with the mayor's office of operations to include these statistics in the mayor's annual report for the city.

Figures 2 shows the result totals of the FDNY rescued/saved indicator reporting system for each borough from January 1 through June 30, 2009. The totals of civilians rescued by the respective FDNY boroughs are: Manhattan 6,201; Bronx 5,198; Staten Island 1,075; Brooklyn 5,938; and Queens 2,332.

Figure 2

Total Number of FDNY Civilian Rescues by Borough January 1, 2009-June 30, 2009



One deficiency revealed by this research is that the FDNY-NYFIRS rescued/ saved indicator is only completed by the incident commander at structural fires unless the fire extends to more than two-alarms. In the FDNY each "alarm" brings three engine companies, two ladder companies and two battalion chiefs to the scene for a total of approximately 60 firefighters plus other specialized support equipment to the scene of an emergency (Griffith, 2009). At second or greater alarms and/or in the event of firefighter or civilian fatalities, serious incident or apparatus accident, the company officer is required to complete a company operations report including all particulars of the incident. The report must specify what functions each company member performed and what equipment they used. At all other emergencies the fire company officer is solely responsible for entering this information (Fire Department, City of New York, 2008c).

Since FDNY company officers are not required to complete incident reports when operating at structural fires less than a second alarm (Fire Department, City of New York, 2008c) there is a potential for rescue/saved/evacuated operations to go un- or under-reported.

Figure 3 gives the number of civilians rescued by the FDNY based on the Top 10 incident types in New York City (J. Manahan, personal communication, November 5, 2009). The incident types are determined by the standards set by the US NFIRS.

Figure 3

Total Number of FDNY Civilian Rescues by Top Ten Incident Types

January 1, 2009-June 30, 2009

NFIRS/NYFIRS Incident Type	Number of Rescues
353–Removal from stalled elevator	12,145
111–Building fires	1,510
322–Motor vehicle accident with injuries	1,421
331–Lock-in/lock-out	1,057
522–Water or steam leak	482
113–Cooking fire, confined to container	448
445–Arcing, shorted electrical equipment	439
352–Extrication of victim(s) from vehicle	388
412–Gas leak	363
311–Medical assistance, assist EMS crew*	297
Total	18,550

Note. *Indicates pre-hospital cardiac arrest patients revived, or patients regaining spontaneous pulse and respirations after arrival and intervention of FDNY personnel. Patient must survive 24 hours and/or be discharged from the receiving medical facility.

5. What methods do the FDNY and other agencies throughout the nation use to compare firefighters with civilian fatalities in the same incidents?

The results of the research into the methods used nationally to compare firefighter and civilian fatalities (following the research into question three) clearly shows that although

different reporting procedures and statistical analyses exist, there is no single published report that produces inclusive information comparing firefighter and civilian fatalities that occur in the same structural fires. It appears that this statistic is readily available to all of the national reporting agencies, such as the NFFF, the NFIRS, the NFPA, and the USFA. However, no such comparison was found to exist.

Likewise, neither the FDNY nor any other fire department contacted for this research (see Appendix G) was found to readily keep such statistics. It was found that although most fire departments rarely suffer firefighter fatalities, those that have rely on memories rather than accurate record keeping to track civilian fatalities in those same fires. An *International Fire Fighter* (International Association of Fire Fighters [IAFF], 2009) article entitled "Working To Live: Making Fire Fighting Safer," suggested the necessity of "revising the existing National Fire Incident Reporting System (NFIRS) to accurately record civilian and firefighter injuries and deaths in residential occupancies" (p. 21). This article's suggestion was in regard to lightweight construction features of newer residential structures—where the majority of civilian and firefighter deaths occur. The IAFF article argues that if these fatalities were thusly reported the fire service would have a stronger argument to enforce the international building code within the US, citing that the new code intends to "provide safety to firefighters" (International Association of Fire Fighters, 2009, p. 21).

The intent of this research is to use the resulting disparity between firefighter and civilian fire deaths occurring in the same fires as a stand-alone statistic to magnify the research problem. This method of comparison can then be utilized to enhance the techniques used by firefighters in conducting risk-versus-reward and size-up analysis as a way to help prevent firefighter fatalities.

6. What are the most recent New York City and national statistics regarding firefighter fatalities during structural fires, and how do they compare with civilian fatalities in the same incidents?

In New York City during 2008, the FDNY suffered two line-of-duty-deaths in two separate structural fire incidents, while civilian fire fatalities totaled 86, the lowest in the preceding 82 years (Fire Department, City of New York, 2009a, 2009d). None of the 86 civilian fire fatalities occurred in the same fires where the FDNY members were killed.

Nationally in 2008, there were 118 firefighter fatalities, including 32 in structural fires (National Fallen Firefighters Foundation, 2009), and 3,320 civilian fire fatalities, an increase of 3.2% over the previous year (Karter, 2009).

The extraordinary conclusion is that of the 32 firefighter line-of-duty-deaths in structural fires in 2008, this research revealed that only four civilian fatalities occurred in those same fires. Similarly, the research revealed that in 2007 there were, again, 118 firefighters killed in the line-of-duty. Of those, 47 died in structural fires (National Fallen Firefighters Foundation, 2009) and only two civilian fatalities occurred in those same fires.

In New York City the last time a civilian fire fatality occurred in the same fire where an FDNY firefighter was killed was on August 13, 1980, when Battalion Chief Frank T. Tuttlemondo perished after throwing himself over a fire lieutenant during a structural fire collapse, saving the lieutenant's life. The only other two documented cases where this same anomaly occurred in New York City was in 1961 when two firefighters and a porter were killed at the Times Tower Fire, and in 1946 when an FDNY communications worker was killed along with a woman he was attempting to rescue from a fire at the Staten Island Ferry Terminal (F. Dwyer, personal communication August 4, 2009).

7. What is the concept of “survivability profiling”?

According to Morris (2009b), survivability profiling is:

> To consider fire conditions and determine if any victims can survive the event as part of the initial and ongoing action plan development….No action plan can be accurately developed until we first determine if the victim can survive the existing fire conditions before rescuers reach them. (p. 6)

Survivability profiling—as being introduced in this research—is the art of making decisions based on known events or circumstances, to determine if civilians can survive existing fire and smoke conditions from inside burning structures (S. Marsar, personal communication, February 12, 2009). According to the Phoenix, AZ Fire Department’s standard operating procedures, “Safety and Risk Management Profiles” (2001) when considering the “SURVIVAL” (p. 1) of any victim in any emergency, members must consider the conditions that are present in the “compartment or area” (p. 1), or the fire and/or hazardous atmospheric conditions affecting the victim’s viability. As examples, the Phoenix, AZ Fire Department procedure includes that:

> A fire in a rear bedroom of a house, with smoke throughout the house may allow a survivable environment if a search and rescue effort is initiated quickly. We may extend risk, in a calculated manner, in theses conditions. A significant fire in a residence with dense smoke under pressure to floor level throughout the building likely means victims could not survive. A very cautious, calculated rescue and fire control operation would be warranted. A well-involved building would like represent a zero survivability profile. Similar conditions in an abandon building would indicate little survivability and little property to be saved. Members should avoid an offensive fire fight. Victims buried by a trench collapse or under water for 10 minutes or more would be unlikely to survive,

> therefore an extremely cautious and well-planned, safe recovery operation is required. (p.1)

The key to the concept of survivability profiling is for firefighters to stop for a few seconds, get the big picture of the incident they are facing, gather as much information as possible and make and educated decision as to the likely probability (*not* possibility) of victim survival. As posed by Klein (1999) firefighters should rely on their intuition and gut feelings to assist them in making these most difficult of decisions. What might be the hardest decision for a firefighter to make is to not enter a burning structure or hazardous area where people might or even are known to be trapped without the possibility of survival.

Outside of the fire and emergency services, profiling is used successfully in many professions, from police agencies to counterterrorism to the medical community. The book *Security Profiling for Survival* (Daniels, 2008) provides for the incorporation of behavior pattern recognition within any organization as an acceptable way to predict human behavioral patterns and tell-tale characteristics of ethnic, regional, social, and even religious groups and individuals.

Police agencies have been using these techniques for years, and the most notable form is that of racial profiling. Although some people feel this is a negative connotation and an offense to fundamental American values, it has proven to be an effective law enforcement tool (Malkin, 2004). Malkin laments that “racial profiling—or more precisely, threat profiling based on race, religion, or nationality—is justified” (p. 1). She states it is also what is keeping the American soil free from terrorism. Citing the war on terror as an example, Malkin continues: “Where else are federal agents supposed to turn for help in uncovering terrorist plots by Islamic fanatics than in mosques” (p. 1). Profiling, says Malkin, “is just one investigative tool among many” (p.2)—as it

is with the fire service where survivability profiling would be an added tool among many in the size-up toolbox.

In the medical field, profiling has been used to predict which patients with colon cancer are most likely to have their disease recur after surgery and who would, therefore, be likely to benefit from additional chemotherapy (European CanCer Conference, 2007). It has also been used to predict survival rates of other diseases and treatments. In one such case of medical profiling, three specific gene expressions (patterns) provide high accuracy in predicting survival rates with early stomach cancer patients following surgery alone (Chen, Lin, Chen, 2005). These researchers concluded that the gene expression profiling may spare some patients from unnecessary treatment, while identifying those with poor prognoses who may wish to undergo further treatment to improve their outcomes.

Whether in the law enforcement, medical, or fire and emergency services professions, profiling is a craft and a tool that can be utilized and enhanced. It may also lead to the survival of individual members.

8. What are the survivability limits for civilians during structural fires?

According to *FireRescue* magazine (2009), “if the space isn’t tenable [for firefighters], the victim isn’t viable—take the time to make it safe and prevent your firefighters from taking unnecessary risks” (p. 6). Similarly, the National Fire protection Association (1986) reports that the upper limits of temperature tenability for humans is considered to be 212 degrees Fahrenheit, well below those temperatures found in most significant structure fires.

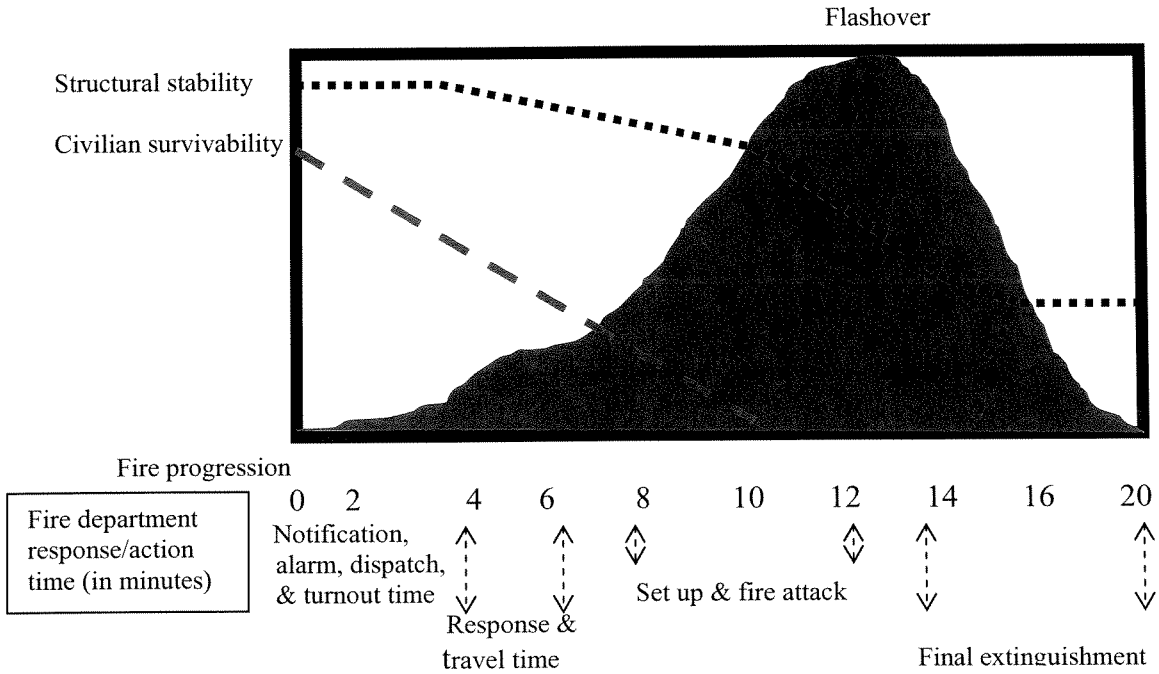
From a size-up point of view, care must be taken to stop and consider the potential benefit to life and property against the risk to firefighters, as the risk generally increases with time. The benefit to civilian occupants tends to decrease with time exponentially unless the fire is

controlled quickly. As the probability of saving lives and property decreases, the degree of acceptable risk should also be reduced (Klaene and Sanders, 2004).

Based on the work of Klaene and Sanders (2004), Figure 4 represents how a fire progresses from ignition through flashover, which is defined as the part of the fire progression process where all contents in an enclosed area are heated, giving off sufficient vapors so that, at approcimately 1,100 degrees Fahrenheit, they will reach their ignition temperature simultaneously (New York State Office of Fire Prevention and Control, 2004, p. 944). Flashover can occur between two and eleven minutes. This is just as firefighters arrive on scene and enter the fire area. The structural stability and survivability lines start at 100%, when the building is at its maximum strength and occupants have the best chance of escape. As the civilian survivability timeline moves toward the horizontal axis, the chance of survival nears zero as the fire and deadly smoke conditions progress. At the same time the structure is continuously losing strength and proceeds toward catastrophic collapse (Klaelne and Sanders, 2004).

Figure 4

Fire Progression, Structural Stability, and Survivability Comparison



In the video presentation “Fire Power” (National Fire Protection Association, 1986) the NFPA creates an actual film that documents what happens as a real-time fire develops and spreads throughout a house. Accurate reporting of conditions as they occur were recorded by video cameras and instruments strategically placed to measure fire progression, temperature, smoke, and gas conditions. These test instruments are the only difference between this house and any other ordinary home. According to the National Fire Protection Association (1986), the film’s objectives are: “(1) to motivate the audience to view fire as a serious threat, and (2) to focus attention on the need for smoke detectors, escape plans and immediate evacuation in the event of fire” (p. 1). One of the audience reactions, as noted in the instructor’s guide (National Fire Protection Association, 1986), is: “the surprise at the frightening speed of the fire’s spread

and the damage inflicted by the fire and smoke throughout the home, particularly in areas remote from the fire room" (National Fire Protection Association, 1986, p. 14).

As the fire begins and grows, a narrator explains what is happening in the fire and throughout the house. Updates noting the times, temperatures, and life-threatening conditions are reported as they occur. A digital clock showing the minutes and seconds counts up based on the appearance of the first flame. Some of the most notably timed events are: 30 seconds: Flames from a living room wastebasket fire ignite the couch; 1 minute, 35 seconds: Smoke builds up rapidly in the living room where the fire began. Gases are noted as leaving the room at more than 190 degrees Fahrenheit; 2 minutes, 30 seconds: The temperature above the couch is 400 degrees Fahrenheit; 2 minutes, 48 seconds: Smoke in the adjacent dining room is only four feet off the floor; 3 minutes, 3 seconds: The temperature three feet above the floor in the living room is more than 500 degrees Fahrenheit…no one could survive; 3 minutes, 41 seconds: Flashover occurs in the living room, sending black acrid smoke into the second-floor hallway; a second way out is the only escape for anyone trapped inside; in less than six minutes, everything in the house was damaged or destroyed, with the exception of the second-floor master bedroom, which had its door closed. While smoke on the hallway side of the master bedroom door reached more than 300 degrees Fahrenheit, the temperature in the room never rose above 77 degrees, and there was practically no smoke damage (National Fire Protection Association, 1986).

The fire progression timeline of the "Fire Power" video (National Fire Protection Association, 1986), and the fire progression timeline in Figure 4 (Klaene and Sanders, 2004) differ, as no two fires are exactly alike. As the National Fire Protection Association (1986) points out: "Some fires may progress slower and some may even grow more quickly dependent on many factors and conditions" (p. 19).

Focusing on the civilian survivability timeline as shown in Figure 4, the relationship of oxygen levels for both humans and fire must be examined. According to the New York State Office of Fire Prevention and Control (2004), the human body and fire are similar in that they both require oxygen to survive. Fire, for example, consumes oxygen and produces toxic gases that may displace, absorb, or dilute the remaining available oxygen. "At 16 or 17% oxygen levels a fire will start to die out or smother due to oxygen deprivation" (pp. 92-93). Atmospheres below 19.5% are considered oxygen-deficient atmospheres (New York State Office of Fire Prevention and Control, 2004, p. 145).

As shown in Figure 5, decreased oxygen affects the human body in a similar fashion. That is, below 19.5% the human body, particularly the brain will start to feel the effects. Below 16 to 17% physical and emotional impairments will be exhibited and below 9 to 10% will cause unconsciousness and eventually death (p. 145). These low oxygen levels do not include the toxic by-products found in smoke during a fire.

Figure 5

Effects of Hypoxia (Reduced Oxygen)

Oxygen Percentage Available	Symptoms
21%	Normal conditions, no effect.
19.5%	OSHA oxygen-deficient atmosphere.
17%	Muscular impairment, rapid breaths.
12%	Dizziness, headache, rapid fatigue.
9%	Unconsciousness.
7 to 6%	Death within a few minutes.

When the by-products of fire—that is, smoke and toxic gases—are added to the oxygen-deficient atmospheres found in most enclosed structure fires, the harmful effect and the speed at which they can incapacitate and kill humans can be readily identified. These toxic by-products

and oxygen-deficient atmospheres have been well documented and extensively researched. One example of this documentation is the article “CO Rx: A Safety Prescription” (Berkman and Hay, 2002), in which the authors chronicle the near-death experience of one FDNY fire officer and the tragic deaths of 10 others over the past 30 years. Each of those deaths resulted from carbon monoxide (CO) poisoning. Berkman and Hay state: “More fire deaths occur from CO poisoning than from any other toxic product of combustion” (p. 16). They illustrate the speed with which CO can incapacitate an individual (within minutes). They also describe CO as “an odorless, colorless, tasteless, and non-irritating gas that is present in all fires” (p. 16) and an “extremely flammable gas that can travel great distances” (p. 17). They further detail how CO crowds out oxygen from the blood, poisoning the brain and tissues. Berkman and Hay (2002) cite several factors that can lead to CO poisoning: (1) the level of CO in an area, (2) the length of time exposed, and (3) the physical condition and activity of the individual during the exposure (p. 16).

Berkman and Hay (2002) also document the cumulative effects of CO and how the bonding of CO to the blood’s hemoglobin (known as scientifically as COHb) has a “half-life of about five hours” (p. 16). That means that it will take approximately five hours for COHb in a human’s body to drop to half of its current level after the CO exposure has ended.

Carbon monoxide effects are first felt by the parts of the body with high metabolic rates, with the brain and heart being the most sensitive (Berkman and Hay, 2002). Firefighters who are hard at work during a fire will be more susceptible than a more sedentary or moderately active person. The inability to control muscle movements are symptoms of severe exposure and are quickly followed by unconsciousness. In a similar chart to that of Figure 5, Berkman and Hay introduce how the percentage of COHb will affect humans (see Figure 6). Berkman and Hay

refer to a “K” factor in the table (p. 16). The K factor as described by them is “a factor related to the exertion level. The value is: K = 3 for resting or unconscious state, K = 8 for moderate exertion, and K = 11 for strenuous exertion” (p. 16).

Figure 6

COHb Levels and Effects

COHb	Symptoms and Medical Consequences
10%	No symptoms.
15%	Mild headache.
25%	Nausea and serious headache.
30%	Symptoms intensify.
45%	Unconsciousness.
50%	Death.

Comparing similar exposures under rest and exertion:

COHb	CO p.p.m.*	CO% in air	K factor	Exposure time
45%	200,000 p.p.m.	20%	3	45 seconds
45%	200,000 p.p.m.	20%	8	16.9 seconds
45%	200,000 p.p.m.	20%	11	12.3 seconds

At rest it would take 45 seconds to develop 45% COHb levels, while strenuous exertion reduces this time to 12.3 seconds. At 45% COHB, a person is unconscious. **A firefighter will not have time to react.**

Note. *p.p.m. = parts per million in air

In a similar comparison to those presented in Figures 5 and 6, the National Fire Protection Association (1986) reports the human response to carbon monoxide at different concentrations as shown in Figure 7.

Figure 7

Human Response to Carbon Monoxide at Different Concentrations

Carbon Monoxide (CO) In Air	Human Response
0.2 %	Headache after 10 minutes, collapse after 20 Minutes, and death after 45 minutes.
0.3 %	Maximum "safe" exposure for five minutes and danger of collapse in 10 minutes
0.6 %	Headache and dizziness in 1 to 2 minutes and danger of death in 10 to 15 minutes.
1.28 %	Immediate effect. Unconsciousness after 2 to 3 breaths and danger of death in 1 to 3 minutes.

In a more recent study Schnepp (2009) expands on the Berkman and Hay (2002) article. In the DVD "To Hell and Back Volume IV: The Toxic Twins," a 2006 study by the NFPA reveals that 87% of people who died in fires had a toxic blood concentration of cyanide as well as carbon monoxide (the toxic twins). "These victims died from breathing the smoke long before the fire killed them" (Schnepp, 2009).

In the Macomb Township, MI Fire Department's fire and life safety tips they attempt to answer the question, "How Much Time Do I Have to Escape?" According to the brochure, one third of American households answered they would have at least six minutes before a fire in their home would become life-threatening. The truth is, according to the materials (Macomb Township Fire Department, 2009), fires can become deadly to home occupants in as little as 30 seconds. Concurring with Schnepp (2009), the Macomb Fire Department describes how everything in a room doesn't have to be burning to be deadly. Items in the home that are burning and being heated will give off deadly poisonous and toxic gases. These gases will confuse and

disorient people still in the home, making the simplest task (and hence, escape) seem difficult to impossible (Macomb, 2009).

Very quickly smoke will obscure the lights and the daylight coming through the windows. Rooms will become black. The heat will be unbearable. The combustion of poisonous gases and smoke will be choking, blinding, and lethal.

According to the Macomb Fire Department the answer to the question is: “To survive you must act immediately, your time is measured in seconds—not minutes” (p. 2).

As the president of the Cyanide Poisoning Treatment Coalition, Schnepp—an assistant chief in the Alameda County, IN Fire Department—laments that these findings are “critical to firefighters as researchers are now finding that job-related deaths once thought to be related to lack of oxygen, over-exertion, or heart attack in some cases can instead be directly linked back to cyanide poisoning” (Schnepp, 2009).

In the “Toxic Twins” video presentation, Schnepp (2009) contends that fires burn hotter, grow faster, and are more toxic than fires of the past. That sentiment is substantiated by Pindelski (2009) as he explains how demonstration fires reveal that, when ignited, one pound of wood releases 8,000 British Thermal Units (BTUs). A BTU is defined as the scientific measurement of the amount of heat required to raise one pound of water one degree Fahrenheit (New York State Office of Fire Prevention and Control, 2004, p. 939). Conversely, one pound of plastic from today’s environment has been shown to release as much as 19,900 BTUs when it is ignited. Pindelski (2009) describes how household items once made out of wood are now fashioned out of plastics with 44,000 petroleum (plastic) materials currently registered.

The toxic smoke produced by the proliferation of synthetic materials and the extreme temperatures reached in very short durations produce smoke with high levels of hydrogen

cyanide that is 30 times deadlier than that of carbon monoxide (CO) alone. And, as discussed by Berkman and Hay (2002), that can lead to chronic health hazards with accumulative effects. The effects of cyanide and CO together are what form the basis of the "Toxic Twins."

According to Schnepp (2009), cyanide disables the body's ability to absorb oxygen. The human body has an affinity for CO approximately 250 times to one compared with oxygen. Cells begin to die and the body's ability to function and move is quickly impaired. Cyanide impairs the human's ability to think and move. Schnepp uses the analogy: "Cyanide kills your organs, CO kills your blood, and it only takes a matter of seconds" (Schnepp, 2009, at 11:56 run time). At a relatively low concentration of 135 parts per million, cyanide and CO will kill a person in approximately 30 minutes. At 3,400 parts per million (as is found in most enclosed structure fires) survival time is cut to less than one minutes (Schnepp, 2009).

As Schnepp says, "Breathing a little smoke as a firefighter may be an unavoidable part of the job. However, breathing a little bit of smoke every day for 30 years is completely different" (Schnepp, 2009, at 22:30 run time). In the video presentation of "The Toxic Twins," while discussing the proper use of self contained breathing apparatus, the need to change our thinking concerning breathing smoke and to protect firefighters from the effects of cyanide and carbon monoxide poisoning, firefighter Kevin Reilly points out, "The ultimate irony in the fire service is that we are willing to put our lives on the line for complete strangers, but often we don't apply the same precautions to safeguard ourselves" (Schnepp, 2009, at 19:10 run time).

Although there is very little treatment available for carbon monoxide poisoning, that is not the case for cyanide poisoning. Schnepp points out that all patients exhibiting signs and symptoms of smoke inhalation should be treated for cyanide poisoning. Swift recognition and treatment is the key, says Schnepp, because the poison works so fast. The treatment includes

removing the victim to fresh air, providing oxygen at high concentrations, removing clothing and applying wet deacon, and immediate transport. With advanced life support, the treatment progresses, including intubating, starting intravenous fluids, and administering antidotes such as hydroxocobalamin, which is approved by the US Food and Drug Administration for cyanide poisoning. This treatment is for exposed firefighters and civilians alike and it will increase their chance for survival (Schnepp, 2009).

Lastly, in helping to quantify the survivability limits for civilians during structural fires and to answer this specific research question, the research looked beyond the emergency services to the scientific community. The availability of recent studies is extremely limited. However, two studies directly related to this research were found. Although the first experiment, "Respiratory Burns: A Correlation of Clinical and Laboratory Results" (Corbitt et al., 1967), is not as current as the researcher would have liked, it has been discovered that the study's results have not been disputed or replicated since. The second experiment, which is more current, "Theoretical Evaluation of Burns to the Human Respiratory Tract Due to Inhalation of Hot Gases in the Early Stages of Fire (Liu et al., 2005), similarly adds credibility to the limited survival time of trapped occupants in structural fires, and therefore directly relates to this research topic.

Corbitt et al. (1967) conducted a 24-month experiment ending on December 31, 1965, where 27 patients were admitted to their hospital for treatment of pulmonary burns. Each patient met three diagnosed criteria: (1) flame burns involving the face (particularly the mouth and nose); (2) singed nasal mucus membranes; and (3) burns sustained in closed-space fires (p. 157).

Eleven additional patients who had respiratory burns were not included because they didn't meet all three of the study's criteria. Of the 27 patients treated, 24 (87%) died, 18 of which were as a direct result of the respiratory burns. Ventilatory insufficiency resulted in five deaths

within 36 hours of the time of the burn. According to Corbitt et al. (1967) associated body burn surfaces of patients varied from a minimum of 15% to a maximum of 98% and the age range was from five months to 88 years. There were 11 males and 16 females. Corbitt et al. noted that evidence of pulmonary damage did not appear in some patients until at least 36 hours postburn. They also noted that the positive lung sound findings were “always ominous if present at the time of admission” (p. 158). All three patients with such diagnostic signs died in the first 24 hours postburn. Pulmonary edema, defined as “a build-up of fluids in the lungs and respiratory structures” (Limmer and O’Keefe, 2009, p. 394), is detected by listening to the patient’s lungs with a stethoscope. Ten patients developed pulmonary edema and accounted for six deaths (Corbitt et al., 1967).

The influences found by this experiment were that etiolodgical factors such as heat, smoke, and humidity had a direct impact on patients and was instrumental in determining the severity of the given burns and subsequent pulmonary edema. The experiment found that “the expected relative relationship of temperature to the severity of respiratory burns and pulmonary edema was confirmed” (Corbitt et al., 1967, p. 161). This experiment found that subjects (laboratory rats) exposed to a combination of heat and humidity (200 degrees Fahrenheit and 100% humidity) saw a 60% mortality rate after just six to seven minutes. It also found that once smoke was added, the lethal nature of the environment increased dramatically, to over 90%.

The experiment (Corbitt et al., 1967) acknowledges that, although most of the human victims of respiratory burns for this study were subjected to temperatures in excess of the 200 degrees Fahrenheit, some were not. It was concluded that the human victims of respiratory burns were affected by the combination of heat, humidity, and smoke, with “heavy concentrations of smoke (and its associated by-products) being the most damaging to humans, secondary to heat”

(p. 162). It was noted that pulmonary burns pass through three progressive and deteriorating stages: (1) respiratory insufficiency, (2) pulmonary edema, (3) and bacterial pneumonia. According to the study (Corbitt et al., 1967), successful management of pulmonary burns depends upon the timeframe and amount of exposure, and the clinical stage of the patient at the time appropriate therapies are begun.

The results of the experiment indicate that smoke and humidity were just as important in the production of pulmonary burns as was temperature. The study concluded that humans subjected to elevated temperatures (200 degrees Fahrenheit and above) along with moderate to heavy smoke and elevated humidity, were susceptible to respiratory burn injuries almost immediately, and fatality within seven to ten minutes (Corbitt et al., 1967, p. 168).

The second experiment, “Theoretical Evaluation of Burns to the Human Respiratory Tract Due to Inhalation of Hot Gases in the Early Stages of Fire (Liu et al., 2005), “was performed to predict the impact of inhaled hot gas to the nasal tissues during the early stages of fires” (p. 436). The inhalation of these hot gases commonly occurs during structural fires and significantly threatens the recovery of fire victims. These injuries cause thousands of deaths in the US every year. One of the most common reasons of death after burn is the mechanism for inhalation injury that can be attributed to the combination of thermal, hypoxia, which is defined as “the lack of oxygen being delivered to the body’s cells as found in the cessation of breathing” (Lemmir and O’Keefe, 2009, p. 383), and chemical effects of the hot smoke (Liu et al., 2005 p. 436). One conclusion in this more recent study that conflicts with the earlier findings of Corbitt et al. (1967) is: “The effect of relative humidity of surrounding air can be ignored in predicting burns for short-duration exposures” (Liu et al., 2005, p. 445).

The process of thermal injury takes place quickly and the resultant injury often occurs at the early stages of fires. Thus, accurate predictions of early fire temperature elevations are critical (Liu et al., 2005). Those predictions include temperatures of 350 degrees Fahrenheit within three minutes to over 1,200 degrees Fahrenheit within five minutes. To minimize lung injuries when exposed to fires, the time for first-degree burns to occur is a key factor.

In Liu et al., the predicted exposure time to first-degree burns in the upper respiratory tract is 230 seconds while more than 900 seconds is required for first-degree burns to develop in the lower airway. Clearly, according to Liu et al., facing the fire more seriously exposes the human respiratory tract especially if getting away from the immediate fire area was not successful. “Clinicians could quickly evaluate the burn degree after they get to know the time that the patient was subject to fire and the approximate temperatures encountered….This might be beneficial to adopt an appropriate treatment protocol” (Liu et al., 2005, p. 445).

The experiment by Liu et al. concludes that decreasing air velocity while increasing respiratory rate would be helpful to minimize the thermal injury in the respiratory tract. However, it also acknowledges that the education, psychological, and physiological reactions of humans in fire situations may make this a difficult conclusion to be effective (Liu et al., 2005).

Concluding this research question on the survivability limits for civilians during structural fires, the results as presented by Berkman and Hay (2002), Corbitt et al. (1967), Klaene and Sanders (2004), the New York State Office of Fire Prevention and Control (2004), Liu et al. (2005), NFPA (1986), and Schnepp (2009) clearly indicate that civilian survival time is limited from seconds to minutes during a fire and in many instances, to a maximum of only 10 minutes (Corbitt, 1967; Liu et al., 2005).

9. How can the FDNY use survivability profiling to enhance current size-up considerations?

In the FDNY's Strategic Plan 2009-2010 (Fire Department, City of New York, 2009b), the department announced that it will be joining other fire departments from across the nation in collaboration with the Oklahoma State University's Department of Political Sciences to launch a three-year safety performance improvement initiative using potential grant funding from the US Department of Homeland Security/Federal Emergency Management Agency. The goal of the program is "to improve the way in which safety is managed within the fire service and direct management efforts at critical safety-related behaviors, resulting in members' attitudes, values, and beliefs about safety" (p. 6).

The Fire Department, City of New York's (2009b) strategic plan states that adding a research component to the department's current organizational safety management program initiatives will help evaluate the effectiveness of the department's ongoing program. It will also "successfully change the safety culture of the organization in the short and long term and significantly reduce firefighter injuries and death" (p. 6). The department anticipates that hazard risk-reduction functions will be improved by transforming both manager and staff beliefs and behaviors to assist in enhancing safety management.

This program, would be a major step toward providing the needed "cultural change" as identified in the literature review (Burton, 2007; Byrne, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009a; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis, 2009; Sendelbach, 2009a, 2009b; Smith, 2006) to bring about the so-called "change in members' attitudes, values and beliefs about safety" (Fire Department, City of New York, 2009b). If the FDNY is to follow through on the initiative's goals, adopting the principles of the 16 Life Safety

Initiatives (National Fallen Firefighters Foundation, 2004, [Appendix A]) and the IAFC's, Rules of Engagement (Morris, 2009b, [Appendix B]) may provide road maps for this necessary cultural change as presented in the literature review (Burton, 2007; Daniels, 2009; Morris, 2009a; National Fallen Firefighters Foundation, 2004; and Sendelbachm 2009a, 2009b). Unfortunately, the department's commitment to such a program, according to the strategic plan (Fire Department, City of New York, 2009b), is dependent upon grant funding for the initiative to move forward.

Regarding the enhancement of the FDNY's current size-up criteria by using the application of civilian survivability profiling, the results of this research reveal that the attitude of firefighters toward their own safety, commensurate with the likelihood of civilian survivability beyond the first 10 minutes of an advanced fire in an enclosed structure, must be altered (Berkman and Hay, 2002; Corbitt et al., 1967; Klaene and Sanders, 2004; Liu et al., 2005; National Fire Protection Association, 1986; New York State Office of Fire Prevention and Control, 2004; Schnepp, 2009).

The disparity of civilian to firefighter fatalities within these same structural fires (as presented in research question number 5) can be utilized to magnify the need for such a cultural change due to the fact that "firefighters are doing a better job of preventing civilian deaths than they are protecting their own lives" (Markley, 2009, p. 96).

The findings gathered for this research included a short questionnaire (Appendix C), which was developed and distributed to specific FDNY contacts (see Appendix G) to help determine the answers to the research questions. Out of the 10 questionnaires distributed, five were returned prior to the completion of this research project. Three of those questionnaires were acquired during personal interviews with the desired subjects, including Chief of Department

Salvatore Cassano (August 13, 2009), Battalion Chief Gerard Koziak (October 27, 2009) and Battalion Chief Mark Rosenbaum (November 7, 2009).

The results of the interviews (which were specifically focused on the five questions in the questionnaire) and the two remaining questionnaires returned are as follows:

1. During the risk-versus-reward analysis at structural fires, have you or other incident commanders that you know of regularly utilized the *likelihood* of civilian survival as part of your size-up evaluation? Two of the respondents answered yes, that they regularly use civilian survival as one of the factors the incident commander considers in developing a risk management strategy. Two respondents stated that they do not utilize this consideration specifically, but generally, one of them added that it is part of his size-up but it is not done as a conscious individual consideration. The remaining respondent added that he does not believe that the *likelihood* of civilian survival is part of the current FDNY risk-versus-reward analysis, but it should be.

2. If educated in the real scientific facts regarding civilian survivability profiling during structural fires, do you believe that fire officers and firefighters might be able to use it during size-up? Again, two of the respondents stated that they do believe it could be a factor utilized by all members in their size-up. One of the respondents voiced his doubt that relying on survivability profiling alone would be a good benchmark for members in risk-versus-reward analysis. He stated that particularly in the early stages of a afire, it is difficult to ascertain the victim's survivability. He pointed out that many lives are saved because firefighters aggressively search for and rescue victims while relying on their training and personal protective equipment for their safety. The third and fourth respondents were skeptical of using this technique in larger

high-rise buildings such as those found in Manhattan, but, both acknowledged its value to fire officers and firefighters operating in the immediate fire area of those same structures.

3. Do you believe that "survivability profiling" as a size-up tool may be beneficial in helping to reduce firefighter fatalities? All five of the respondents expressed doubt in answering this question. Although each respondent acknowledged the value and merit of such a technique, each one concluded that many other factors come into play in firefighter fatalities. One added that quantifying civilian survivability profiling may be difficult to achieve, and that operational risk management is about controlling risks, not avoiding risks at all.

4. In addition to the FDNY's traditional 13-point size-up, what other criteria (if any) have you utilized in deciding attack strategies and tactics? The responses included: the FDNY Critical Incident Dispatch System (CIDS), defined by the Fire Department, City of New York (1999), as a system that:

> uses the computer dispatch message to provide critical information about specific buildings to all responding units. The system alerts units to dangerous or hazardous conditions which are not necessarily apparent from the front of the building. It also provides accurate and consistent information for required fire, emergency, and radio progress reports. (p. 4-1)

Additional factors identified by the respondents include: incident commander experience, reports of people on scene (both firefighters and civilians), expected response times of resources not yet on scene, the quality and quantity of on-scene radio communications, ongoing construction/alterations of the building, the size of the building, and reported occupant behavior (such as self-evacuation, etc.).

5. Other than September 11, 2001, when was the last time an FDNY firefighter was killed in the line-of-duty where a civilian was also killed? Not one of the five respondents was able to recall such an incident. It should be noted that three of the respondents have over 30 years' experience in the FDNY while the other two have over 20 years' experience. This researcher was able to find the answer to this question as being August 13, 1980 (F. Dwyer, personal communication, August 4, 2009).

Summarizing the results of this research project, "until we are willing to make the required cultural changes, the American fire-rescue service will continue to lose 100-plus members each year" (Rubin, 2006, p. 103). He continues that a true transformation is required in crew resource management to keep our firefighters safe. The results of this research indicate that all members of the fire service must adopt a safety mindset. Each individual is responsible for his own life as well as the lives of others. Rubin (2006) relates that our history and culture point to the fact that we are slow to change. We tend to make significant changes following disasters. We do so reluctantly and in all too many cases only due to legislation.

The fire service must also train and educate our members on the realistic and limited survivability of civilians during structural fires. As this research points out, firefighters must put their lives at risk, in a calculated manner, only when there are SAVABLE LIVES to be saved (National Fire Protection Association, 2007, Annex A).

Discussion

The catalyst for this Applied Research Project is the fact that over the 19-plus years that the author has been a member of the FDNY, 32 FDNY firefighters have been killed in the line-of-duty at structural fires. And the additional underlying fact is that not one civilian was killed in any of those same fires (excluding the terrorist attacks of September 11, 2001).

The study's results clearly compare and agree with the findings of other published works as presented in the literature review. Namely, that firefighters are being killed in disproportionate numbers compared with civilians in the same fires. Common reemerging themes discovered throughout the literature review and research results include the necessity for a cultural change in the US fire service when considering the risk of firefighters' lives and the realistic survivability of civilians (Burton, 2007; Byrne, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009a; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis, 2009; Sendelbach, 2009a; Smith, 2006). Additionally, as part of that cultural change, a challenge for US firefighters is to develop an attitude that does not accept line-of-duty-deaths as part of the job (Marinucci, 2009; Crawford, 2007).

The overriding focus for this research project is the need to reduce the number of US firefighter fatalities in general and the FDNY specifically (Burton, 2007; Byrne, 2007; Daniels, 2009; Dedman, 2005, Fahy et al., 2007; Grimwood, 2008; Halton, 2008; Marinucci, 2009; Eisner, 2009b; Morris, 2009a; National Fallen Firefighters Foundation, 2004; Sendelbach, 2009a; Wood, 2008). The disparity of firefighter to civilian fire deaths in the same incidents as detailed in the study's results points to the need for greater education on the part of firefighters and the need to adjust current size-up techniques (Byrne, 2007; Crawford, 2007; Markley, 2009; Morris, 2009a; Smith, 2006). Firefighters and fire officers need the educational tools to understand which conditions provide for a savable life and which ones do not.

Considering the scientific findings on survivability time limits and respiratory limitations of civilians under fire, smoke, and toxic gas conditions (Berkman and Hay, 2002; Corbitt et al., 1967; Klaene and Sanders, 2004; Liu et al., 2005; Macomb Township Fire Department, 2009; National Fire Protection Association, 1986; New York State Office of Fire Prevention and

Control, 2004; Pindelski, 2009; Schnepp, 2009), firefighters may utilize survivability profiling to decide if the risk is truly worth the reward or rather, is their life worth giving up considering the fire and smoke conditions present in front of them. As Morris (2009b) points out, we must first determine if victims can survive the existing fire conditions before rescue attempts to reach them are begun.

The National Fallen Firefighters Foundation's (2004) 16 Life Safety Initiatives (Appendix A) and the IAFC's (Morris, 2008) Rules of Engagement (appendix B) have set the groundwork to educate and adopt the identified cultural change. The researcher believes that these foundations will allow firefighters to stop and look at how we've done business in the past, acknowledge how different and complex our firefighting world has become, and be open to the fact that the fire education we received in the past may not always be valid in today's quickly evolving, hostile and ever-changing fire environments.

As an interior structural firefighter, the author finds himself conflicted over the concept of survivability profiling. It is the author's interpretation of the study results that the concept of survivability profiling, as part of a basic size-up routine, is one that is clearly supported by the literature review and study results. Admittedly, however, it is difficult to imagine having to make the decision not to enter and search for civilians that may or are known to be trapped based upon such considerations. The author would like to believe that if the fire and smoke conditions were so severe, that such an educated decision would come easily based on experience and/or instincts as described by Breen (2000), Campbell (2000), and Klein (1999). However, as in the case of the Keokuk IA firefighter fatalities (Dedman, 2005), if a family member was standing outside the structure with soot on their face telling me that there is definitely someone trapped inside—

unless entry was impossible due to the fire, heat, and smoke conditions—it would be difficult not to enter and search for those trapped.

But the author would like to think that after conducting this research project, if a few extra seconds were taken to assess the overall situation and determine that the conditions were so severe that the survival of anyone trapped inside was extremely doubtful or impossible, then he would stop and not enter, nor would he allow other firefighters to enter, based on the concept of survivability profiling and the limits of human survival times (Berkman and Hay, 2002; Corbitt et al., 1967; Klaene and Sanders, 2004; Liu et al., 2005; Macomb Township Fire Department, 2009; National Fire protection Association, 1986; New York State Office of Fire Prevention and Control, 2004; Pindelski, 2009; Schnepp, 2009). The author also acknowledges that thousands of civilians are saved annually because firefighters take risks and find them—albeit, many of those were calculated risks based on risk-versus-reward analysis.

Another conflict or question, as pointed out by S. Raynis (personal communication, August 24, 2009) in answering the FDNY incident commander questionnaire (Appendix C) is: How can we quantify the act of survivability profiling? The author agrees. Although the research results point out that the survivability time limits for civilians can certainly be quantified and reasonably fixed by time, it is difficult to develop guidelines or benchmarks with which to measure those limits at the fire scene. This is due to several conditions: (a) the fact that every fire is different and acts differently, (b) in larger structures there can exist remote areas that may not be affected severely by heat and smoke, and (c) it is difficult to know where the fire is in relation to a fire progression timeline or how long the fire has been burning. An exception may be for firefighters to rely on past experience, together with their knowledge of fire progression and reading smoke, and their tell-tale signs (Breen, 2000; Campbell, 2000; Klein, 1999).

Supported by the literature review and the results of this study, this conflict is where the cultural change must come in. It begins with individual firefighters and fire officers who are willing to make these tough decisions and possibly save the lives of themselves or other firefighters. This very concept was employed by District Chief Mike McNamee of the Worchester, MA Fire Department in December 1999 after losing six firefighters in a stubborn fire, when he stopped other firefighters from running in and making the death toll even higher.

A final component to the research results is that education may perhaps be the best defense and the first step toward lowering firefighter fatalities—to learn the signs and conditions that would lead a firefighter to say no, it's too risky to enter. This is an addition to basic fire and smoke behavior (Breen, 2000; Klein, 1999; Morris, 2009a).

The implications for the FDNY based on the research include a required cultural change in the thought process of its firefighters, fire officers, staff chief and incident commanders concerning unnecessary risks, and the *firefighter duty to die syndrome* (Burton, 2007; Byrne, 2007; Crawford, 2007; Daniels, 2009; Goldfeder, 2007; Halton, 2009a; Markley, 2009; National Fallen Firefighters Foundation, 2004; Raynis 2009; Sendelbach, 2009a, 2009b; Smith, 2006). Additional implications for the FDNY include placing the responsibility for size-up and personal safety on each individual member rather than a cultural reliance on the officers and incident commanders to do so. Furthermore, incident commanders and fire officers must not hesitate to stop firefighters from performing tasks that they consider to be incorrect, too risky or too dangerous. Likewise, all firefighters should have the backing to stop any unsafe actions that they see (Morris, 2009a). The end result and implications of this research are to assist in reducing firefighter fatalities throughout the nation and in the FDNY specifically, by applying survivability profiling.

Recommendations

After significant research and analysis, the author has developed specific recommendations to assist in solving the problem and purpose statements of this project. These recommendations represent positive additions and potential improvements to the already successful FDNY operations and its 145 years of service, dedication, and sacrifice.

Based on this research, the next course of action for the FDNY should be to:

1. Update the FDNY 13-point size-up criteria (Firefighting Procedures, Ladder Company Operations: Tenements, section 1.6) (Appendix D) to more closely reflect those recommended by the NFFF's 16 Firefighter Life Safety Initiatives (National Fallen Firefighters Foundation, 2004) (Appendix A) and the IAFC's (IAFCs) Rules of Engagement For Structural Firefighting (Morris, 2009b) (Appendix B). Specifically, the order of the size-up considerations should be changed to reflect a prioritized list with "Life" being the first consideration, and the lives of FDNY firefighters taking precedence over all others. Adopting updated FDNY size-up strategies built upon the IAFC's Rules of Engagement in particular will help meet the stated purpose of this research for all ranks of the department.

2. Immediately remove the words "aggressive interior attack" from all FDNY books and training materials. This term should be replaced with a phrase more commensurate with the department's commitment to the safety of its members. For example: "an intelligent, well-coordinated, cautious, and calculated course of action to mitigate the fire or emergency." This type or similar wording adds the connotation that the fire attack will be carried out, but, it may not always be aggressive and it may not always be interior.

3. Begin a training program (or enhance existing training programs) at all levels of the FDNY to address the firefighter's mindset toward accepting risks and the "Firefighter Duty To

Die Syndrome" (Crawford, 2007). As expressed by the firefighters interviewed for the results of this research, this mindset—commensurate with the ever-decreasing chances of survival for civilians beyond the first 10 minutes of an advanced enclosed structure fire, and the fact that not one civilian has been killed in the structural fires that have killed 32 FDNY firefighters over the last 20 years—is a good incentive for such a training program. The research results illustrate the disparity of civilian fatalities versus firefighter fatalities in the same structural fires and provide a good foundation for this training program. Reducing firefighter fatalities would be the program's objective.

The problem statement of this research addresses this very theme: The current mindset and traditional size-up criteria utilized by the department may unnecessarily put members at risk when there are no civilian lives to be saved. Specifically, firefighters must change the way they look at risk and savable lives. The research supports that firefighters, particularly in the FDNY, must consciously approach life, under the risk-versus-reward analysis, with the acceptance that their own life comes first. To risk their life for that which can be saved is what guides the firefighter to this noble calling. However, the individual firefighter should be able to assess the odds of a savable life by utilizing survivability profiling.

4. Assign a committee to further investigate the concept of survivability profiling based on the FDNY-NYFIRS and the NFIRS statistics in an attempt to quantify the concept into a measurable and reliable procedure.

5. Adopt the concept of *survivability profiling* as an acceptable form of risk management based on the research results presented in this project.

6. On a broader, national scope, all agencies involved with investigating and reporting on firefighter fatalities and US fire statistics, such as the NIOSH, the OSHA, the NFPA, the USFA,

the NFFF, and the NFIRS, should include in their written summaries a comparative statistical component showing civilian and firefighter fatalities that occur in the same fires. It would be hoped seeing these statistics may assist firefighters to stop and question the obvious disparity and readjust their thinking concerning risk-versus-reward analysis.

A national required statistic as part of the NFIRS containing the number of civilians rescued and saved (as the FDNY is currently piloting) would also go a long way in documenting what the fire service does every day both nationally and in New York City.

Recommendations for future researchers of this topic would be to investigate the reasons why fire departments that report to the NFIRS do not consistently provide civilians rescued and saved statistics. A related topic would be why fire departments also do not report firefighter injuries and fatalities to NFIRS as required under the basic NFIRS module. It would be beneficial for a future researcher to devise such an analytic device or system to track these vital statistics.

In the tough economic times that are facing our nation and the fire service, being able to readily show the number of lives we positively affect on a routine basis may go a long way when negotiating budgets and fighting for efficient staffing levels. The lack of reporting and such an evaluative tool, in and of itself, could produce an acceptable problem and purpose statement.

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Appendix A

16 Life Safety Initiatives (National Fallen Firefighters Foundation, 2004)

(1) Define and advocate the need for cultural change within the fire service relating to safety, incorporating leadership, management, supervision, accountability, and personal responsibility.

(2) Enhance the personal and organizational accountability for health and safety throughout the fire service.

(3) Focus greater attention on the integration of risk management with incident management at all levels, including strategic, tactical, and planning responsibilities.

(4) Empower all firefighters to stop unsafe practices.

(5) Develop and implement national standards for training, qualifications, and certification (including regular recertification) that are equally applicable to all firefighters, based on the duties they are expected to perform.

(6) Develop and implement national medical and physical fitness standards that are equally applicable to all firefighters, based on the duties they are expected to perform.

(7) Create a national research agenda and data collection system that relate to the initiatives.

(8) Utilize available technology wherever it can produce higher levels of health and safety.

(9) Thoroughly investigate all firefighter fatalities, injuries, and near misses.

(10) Ensure grant programs support the implementation of safe practices and/or mandate safe practices as an eligibility requirement.

(11) Develop and champion national standards for emergency response policies and procedures.

(12) Develop and champion national protocols for response to violent incidents.

(13) Provide firefighters and their families access to counseling and psychological support.

(14) Provide public education more resources and champion it as a critical fire and life safety program.

(15) Strengthen advocacy for enforcement of codes and the installation of home fire sprinklers.

(16) Make safety a primary consideration in the design of apparatus and equipment.

Appendix B

Rules of Engagement for Structural Firefighting (International Association of Fire Chiefs, Draft, March 2009)

Rules of Engagement for Firefighter Survival:

- Size-Up Your Tactical Area of Operation.
- Determine Victim Survival Profile.
- DO NOT Risk Your Life for What Is Already Lost.
- Extend LIMITED Risk to Protect SAVABLE Property.
- Extend CALCULATED Risk to Protect SAVABLE Lives.
- Be Continuously Aware of Your Surroundings and Fireground Communications.
- You Are Authorized to SAY NO to Unsafe Practices or Conditions. Stop, Talk, and Decide.
- You Are Authorized to Abandon Your Position and Retreat When Conditions Deteriorate.
- Never Hesitate to Declare a Mayday if Needed.

Rule of Engagement for Incident Commanders:

- Immediately Conduct, or Obtain, a 360-Degree Size-Up of the Fireground.
- Determine Victim Survival Profile.
- Conduct Risk Assessment and Develop A SAFE ACTION PLAN.
- If You Don't Have the Resources to Protect Firefighters—Consider Defensive Operations.
- DO NOT Risk Firefighter Lives for What Is Already Lost—Consider Defensive Operations.
- Extend LIMITED Risk to Protect SAVABLE Property.
- Extend Very CALCULATED Risk to Protect SAVABLE Lives.
- Firefighters Are Authorized to SAY NO to Unsafe Practices and Conditions. Stop, Talk, and Decide.
- Keep Interior Crews Informed of Changing Conditions.
- Conduct a Continuous Risk Assessment—Revise the Action Plan.
- After Search and Rescue is Completed, if There is No Progress Towards Fire Control, Seriously Consider Withdrawal of Crews.
- Always Have a Rapid Intervention Team in place.

Appendix C

FDNY Incident Commander Questionnaire

Dear Chief,

I am Stephan Marsar, a covering Captain assigned to the third division. Currently I am working on my final Applied Research Project for the National Fire Academy's Executive Fire Officer Program.

The focus of this final project is on the national disparity between firefighter fatalities versus civilian fire fatalities that occur at the same structural fires. The project will introduce "survivability profiling" as an added technique to be used during size-up at these incidents.

Survivability profiling is a tool to assist in making educated assumptions (based on scientific facts) about the likelihood of civilians being trapped and if they are, the likelihood of them surviving (or lack thereof). This profiling is based on fire and/or smoke conditions found on, and subsequent to, the fire department's arrival. This added size-up criteria may be used prior to committing members to search and rescue operations. The ultimate goal of this research is to help reduce firefighter fatalities when there are no civilian lives to be rescued.

I hope that you can take just a few moments to answer the following questions. Your input will prove invaluable to my research and the project's significance to our department and the national fire service. Please return the completed survey to me via email at: stephenmarsar@yahoo.com prior to Friday, October 23, 2009.

I know your schedule is busy, but thank you in advance for your cooperation and experienced insight in this matter. Please feel free to elaborate on any answers you feel may need more explanation or detail.

Respectfully,
Stephen Marsar, Captain
Division 3

1. During the risk-versus-reward analysis at structure fires, have you or other ICs that you know of, regularly utilized the *likelihood* of civilian survival as part of your size-up evaluation?
2. If educated in the real scientific facts regarding civilian survivability limits during structural fires, do you believe that fire officers and firefighters might be able to use it during size-up?
3. Do you believe that "survivability profiling" as a size-up tool may be beneficial in helping to reduce firefighter fatalities?
4. In addition to the FDNY's traditional 13-point size-up, what other criteria (if any) have you utilized in deciding attack strategies and tactics?
5. Other than September 11, 2001, when was the last time an FDNY firefighter was killed in the line-of-duty where a civilian was also killed?

Appendix D

FDNY Firefighting Procedures, Ladder Company Operations: Tenements

1.5 GENERAL AREAS OF RESPONSIBILITY.

1.5.1 FIRST LADDER COMPANY TO ARRIVE:

A. Ladder company operations on fire floor.

B. Determine life hazard and rescue as required.

C. Roof ventilation and a visual check of rear and sides from this level.

D. Laddering as needed.

E. If second ladder company will not arrive within a reasonable time, make interior search and removal of endangered occupants above the fire.

1.5.2 SECOND LADDER COMPANY TO ARRIVE

A. *All floors above the fire floor* for search, removal, ventilation and to check for fire extension.

B. Confirm roof ventilation. (assist first unit)

C. Check rear and sides of buildings.

D. Reinforce laddering and removal operations when necessary.

1.6 SIZE UP

Is an ongoing evaluation of the problems confronted within a fire situation. Size up starts with the receipt of the alarm and continues until the fire is under control. This process may be carried out many times and by many different individuals during a fire.

1.6.1 The factors which all members must consider in size-up are:

A. ***Time***
Governs the life hazard. Night fires mean poor visibility, buildings locked effecting delay in access. A tenement fire is more serious at night than in daytime.

B. ***Life***
The most serious factor at any fire. What is the location of the life hazard in relation to the fire. Life hazard to firefighters must also be considered.

C. ***Area***
Building or occupancy area. Large areas to be searched requiring search lines. Large areas generate fires of great intensity, heavy volumes of smoke and severe heat.

D. ***Height***
Building height will govern the use of the Aerial and/or Tower Ladder and portable ladders.

E. ***Construction***
Non-fireproof, contains vertical voids that allows for extension. Alterations may have introduced larger voids, both vertical and horizontal. Wooden "I" beams, lightweight truss, *Energy Efficient Windows* and membrane roofs can affect the safety of operations within the structure. The presence of front or rear fire escapes or party balconies, will also have an effect on fireground operations.

F. ***Occupancy***
This determines the severity of the life hazard and the intensity of the fire. *For example:* A commercial occupancy with an increased fire load on the first floor with apartments above.

G. ***Location and Extent of Fire***
A fire in the cellar, shaft, or apartment on the top floor will determine access and areas to be searched.

H. ***Water Supply***
Hydrant availability, and the placement and readiness of hoselines.

I. ***Street Conditions***
Effect apparatus access and the placement of Aerial/Tower ladders to the fire building.

J. ***Auxiliary Appliances***
Standpipe/sprinkler systems, and the location of outlets, O S & Y, and/or check valves.

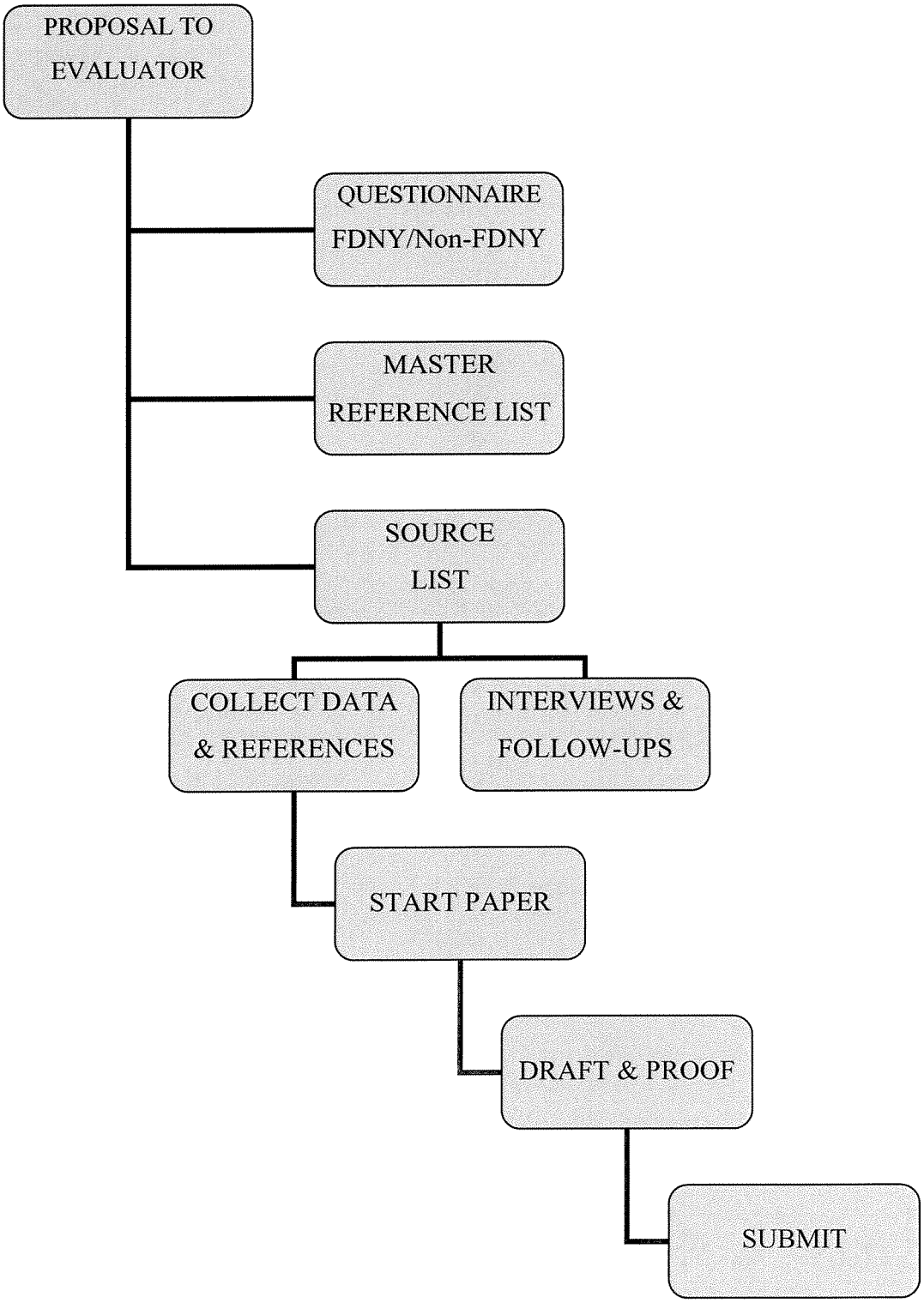
K. ***Weather***
Snow and freezing conditions, wind velocity and direction are major factors in safety and fire operations.

L. ***Apparatus and Equipment***
Be aware of the units on the scene. The arrival of those units assigned on the alarm, Engines and Ladders, 1st due, 2nd due, etc..

M. ***Exposures***
May be adjoining buildings or areas within the fire building itself (auto exposure) e.g., floor to floor via windows, and across shafts or adjoining apartments.

Appendix E

Road Map to Success



Appendix F

ARP Required Elements and Timeline

SECTION	TARGET DATE	COMPLETED	Proof 1	Proof 2
1. Title Page	_____	☐		
2. Certification Page	_____	☐		
3. Abstract (Separate page)	_____	☐		
4. Table of Contents (Separate page)	_____	☐		
5. Main Body Sections	_____	☐		
Introduction (Separate page)	_____	☐		
Background & Significance	_____	☐		
Literature Review	_____	☐		
Procedures	_____	☐		
Results	_____	☐		
Discussion	_____	☐		
Recommendations	_____	☐		
6. Reference List (Separate page)	_____	☐		
7. Appendices (Optional)	_____	☐		

Appendix G

Master Source List (in contact order)

NAME	AFFILITATION	CONTACT NUMBER
Gayle Kelch	USFA-NFIRS Specialist	xxx-xxx-xxxx
Mark Whitney	Fire Programs Specialist, USFA	xxx-xxx-xxxx
IAFC Office	Interational Assoc. of Fire Chiefs	xxx-xxx-xxxx
Capt. Pat Kilgallen	FDNY-NYFRS Coordinator	xxx-xxx-xxxx
Phil McLaughlin	National Fallen Firefighters Fdn.	xxx-xxx-xxxx
Nancy Schwartz	National Fire Protection Assoc.	xxx-xxx-xxxx
Dan May	FDNY Mand Library	xxx-xxx-xxxx
Chief Gary Morris	IAFC Director, Safety, Health & Survival Section	xxx-xxx-xxxx
Battalion Chief Raynis	FDNY Chief of Safety	xxx-xxx-xxxx
Salvatore J. Cassano	FDNY Chief of Department	xxx-xxx-xxxx
Deputy Asst. Chief Manahan	FDNY Strategic Planning	xxx-xxx-xxxx
Battalion Chief Rosenberg	FDNY Battalion 8	xxx-xxx-xxxx
Battalion Chief Salka	FDNY Battalion 18	xxx-xxx-xxxx
Frank Dwyer	FDNY-PIO	xxx-xxx-xxxx
Dep. Chief Shane Lo	Operations Chief, Hong Kong F.D.	xx-xxx-xxx-xxxx
Scott Salman	Boston, MA F.D.-PIO	xxx-xxx-xxxx
Battalion Chief Ed Simeona	OSHA/Safety Honolulu, HI F.D.	xxx-xxx-xxxx
Mark Savage	LA County, CA F.D.	xxx-xxx-xxxx
Carlos Calvillo	LA City, CA F.D.-PIO	xxx-xxx-xxxx
Chief Javier Mainar	San Diego, CA F.D.	xxx-xxx-xxxx
Asst Chief Todd LeDuc	Chief of F.D. Ops Broward Co. Sheriff	xxx-xxx-xxxxx
Battalion Chief Mike Scott	Kent, WA F.D.	xxx-xxx-xxxx
Chief of Ops. Garret Olsen	Scottsdale, AZ F.D.	xxx-xxx-xxxx
Battalion Chief T. Vaughn	Lenexa, TX F.D.	xxx-xxx-xxxx
Dep. Chief Rick Merryfield	Eau Claire, WI F.D.	xxx-xxx-xxxx

Appendix H

US Structural Firefighter Fatalities 2007 & 2008

2007

Firefighter's Name	Department	State	Date of Death	Number of Civilians Killed in Same Fire
Sidney A. Hall	Upland Vol. F.D.	IN	1/3/2007	0
Jeremy C. Adams	Springfield F.D.	FL	1/9/2001	0
Shane M. Daughetee	Highway 58 Vol. F.D.	TN	1/26/2007	0
Jeremy C. LaBella	Washington F.D.	PA	2/4/2007	0
Joseph T. Torkos	Detroit F.D.	MI	2/7/2007	0
Theodore M. Abriel	Albany F.D.	NY	2/19/2007	0
William F. Grant	Chicago F.D.	IL	3/23/2007	0
Billy H. Williams[X]	Rhodestown Vol. F.D.	NC	3/24/2007	0
Brandon M. Whimple[X]	Rhodestown Vol. F.D.	NC	3/24/2007	0
Kyle W. Wilson	Prince William Co. F.D.	VA	4/16/2007	0
William D. Church	Columbus Vol. F.D.	PA	5/3/2007	0
Bruce J. Zumwalt	Sheldon District F.D.	IL	5/6/2007	0
Peter Beebe-Lawson	Springfield F.D.	ME	5/7/2007	0
Brandon L. Daley	Butler Co. Fire District 3	KS	5/11/2007	0
John F. Keane	Waterbury F.D.	CT	5/19/2007	0
Dennis Cheshire	Red Oak Area Vol. F.D.	AL	5/20/2007	0
Felix M. Roberts	Fulton Co. F.D.	GA	5/28/2007	0
Theodore M. Benke*	Charleston F.D.	SC	6/18/2007	0
Louis M. Mulkey*	Charleston F.D.	SC	6/18/2007	0
Mark W. Kelsey*	Charleston F.D.	SC	6/18/2007	0
Bradford R. Baity*	Charleston F.D.	SC	6/18/2007	0
Michael J. French*	Charleston F.D.	SC	6/18/2007	0
James A. Drayton*	Charleston F.D.	SC	6/18/2007	0
Brandon K. Thompson*	Charleston F.D.	SC	6/18/2007	0
Melvin E. Champaign*	Charleston F.D.	SC	6/18/2007	0
William H. Hutchinson*	Charleston F.D.	SC	6/18/2007	0

2007 & 2008 US Structural Firefighter Fatalities (continued)

Firefighter's Name	Department	State	Date of Death	Number of Civilians Killed in Same Fire
Daniel F. Pudjak	F.D.N.Y	NY	6/21/2007	0
Timothy L. Sanborn	Clinton Area Fire Rescue	MI	6/22/2007	0
Scoot P. Desmond**	Contra Costa Co. F.D.	CA	7/21/2007	2
Matthew C. Burton**	Contra Costa Co. F.D.	CA	7/21/2007	2
Cornelius M. Nolton	Newark F.D.	NJ	7/23/2007	0
Jon C. Trainer	Mechanicsburg F.D.	OH	7/24/2007	0
Austin H Cheek***	Noonday Vol. F.D.	TX	8/3/2007	0
Kevin G. Williams***	Noonday Vol. F.D.	TX	8/3/2007	0
Anthony P. Cox	Topeka F.D.	KS	8/13/2007	0
Joseph P. Graffagnino+	F.D.N.Y.	NY	8/18/2007	0
Robert C. Beddia+	F.D.N.Y.	NY	8/18/2007	0
Warren J. Payne++	Boston F.D.	MA	8/29/2007	0
Paul J. Cahill++	Boston F.D.	MA	8/29/2007	0
Jared W. Zimmerly	Prairie Township F.D.	OH	9/9/2007	0
Leonard R. Bailey	Elizabeth Vol. F.D.	PA	9/12/2007	0
William D. McDaniels	Mocanaqua Vol. F.D.	PA	9/15/2007	0
Michael D. Reagan	Sharon Hill F.D.	PA	9/26/2007	0
Robert W. Phillips	Athelstane Vol. F.D.	WI	10/25/2007	0
Jeremy W. Wach	Wymore Fire Rescue	NE	11/5/2007	0
Carl S. Engdahl	McPherson Co. Rural F.D.	KS	11/12/2007	0
Water C. Fagan	East Greenwich Twnshp. Fire/Res	NJ	12/28/2007	0

2007 Notes

x = Two firefighters killed in the same fire, Rhodestown, NC
* = Nine firefighters killed in the same fire, Charleston, SC
** = Two firefighters killed in the same fire, Contra Costa County, CA
*** = Two firefighters killed in the same fire, Noonday, TX
+ = Two firefighters killed in the same fire, New York, NY
++ = Two firefighters killed in the same fire, Boston, MA

2007 & 2008 US Structural Firefighter Fatalities (continued)

2008

Firefighter's Name	Department	State	Date of Death	Number of Civilians Killed in Same Fire
Paul L. Ellington	Oregon Hill Vol. F.F.	NC	1/1/2008	0
John H. Martinson	F.D.N.Y.	NY	1/3/2008	0
James L. Robeson	Scranton F.D.	PA	1/6/2008	2
Harvey Jordan	Penn Hills #1 Vol. F.D.	PA	1/7/2008	0
Johnny Bajusz	Layton Vol. F.D.	FL	1/16/2008	0
Robert L. McAtee	Huttonsville-Mill Creek Vol. F.D.	WV	1/20/2008	1
Vance R. Tomaselli	San Bernardino Co. F.D.	CA	2/16/2008	0
Michael J. Hayes	Brazos Canyon Vol. F.D.	NM	2/19/2008	0
Bradley P. Holmes	Pine Township Eng. Co.	PA	2/29/2008	1
Nicholas V. Picozzi	Lower Chichester Vol. F.D.	PA	3/5/2008	0
Justin E. Monroe[X]	Salisbury F.D.	NC	3/7/2008	0
Victor A. Isler[X]	Salisbury F.D.	NC	3/7/2008	0
Raymond Barrett Sr.	West Milford Township F.D.	NJ	3/9/2008	0
Walter W. Michl	Roanoke-Wildwood Vol. F.D.	NC	3/16/2008	0
Terreance D. Crockett	Kansas City F.D.	MO	3/17/2008	0
Brent A. Lovrien	Los Angeles City F.D.	CA	3/26/2008	0
Eric D. Speed	Caddo Parish Fire Dist. Two	LA	3/28/2008	0
Brian W. Shira*	Colerain Township Dept. of Fire	OH	4/4/2008	0
Robin M. Broxterman*	Colerain Township Dept. of Fire	OH	4/4/2008	0
Rickey S. Morris**	Sedalia F.D.	MO	4/8/2008	0
Michael D. Crotty**	Lawrence Park Township Vol. F.D.	PA	4/8/2008	0
Charles C. Fraley	Macon F.D.	MS	4/12/2008	0
Robert L. Knight	Teague Vol. F.D.	TX	7/5/2008	0
Ryan T. Baxter	West Hill F.D.	NY	7/8/2008	0

Brian J. Munz	Fairbury F.D.	IL	7/22/2008	0
Firefighter's Name	**Department**	**State**	**Date of Death**	**Number of Civilians Killed in Same Fire**
Adam C. Renfroe	Crossville F.D.	AL	10/29/2008	**0**
Walter P. Harris	Detroit F.D.	MI	11/15/2008	**0**
Michael D. Snowman	Hartland Vol. F.D.	ME	11/17/2008	**0**
Robert J. Ryan Jr.	F.D.N.Y.	NY	11/23/2008	**0**
Richard L. Montgomery* **	Pisgah Community Vol. F.D.	MS	12/31/2008	**0**
Jarrett L. Little	Walker Co. Fire Rescue	GA	12/31/2008	**0**

2008 Notes.

x = Two firefighters killed in the same fire, Salisbury, NC
* = Two firefighters killed in the same fire, Colerain Township, OH
** = 4/8/2008: two firefighters killed in separate fires-Sedalia, MO and Lawrence Park, PA
*** = 12/31/2008: two firefighters killed in separate fire-Pisgah, MS and Walker County, GA