21ST CENTURY RISK REDUCTION

METHODOLOGIES FOR

THE FIRE SERVICE

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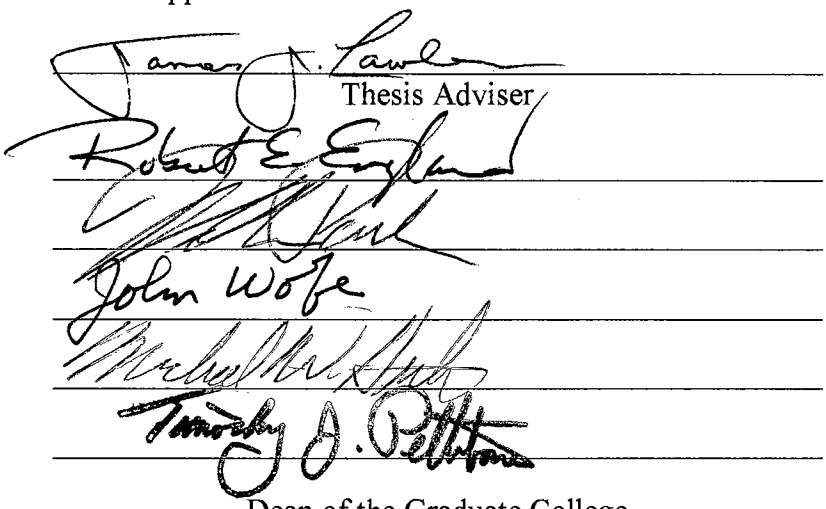

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Chapter 1-Introduction

Importance of the Project

The National Fire Protection Association (NFPA) promulgated standard 1710 provides specific recommendations to professional fire departments in the areas of response, staffing, and deployment. This consensus standard, passed in May 2001, presents challenges and opportunities to organizations and communities. NFPA 1710 presents challenges because it calls for specific requirements for service delivery.

NFPA 1710 requires four-minute response times to all fires and requests for basic life support (BLS) emergency medical service (EMS) for the first resource. It also calls for eight-minute response times for advanced life support (ALS) medical emergencies and complete assignment arrival at fires. The standard also refers to handling of all calls for emergency service from fire departments, regardless of type, in less than one minute. It also recommends minimum staffing of four persons per fire vehicle one hundred percent of the time. Furthermore, it requires a provision for immediate deployment of rapid intervention crews (RIC). Additionally, the goals of the time requirements must be accomplished ninety percent of the time.

Achieving the goals of 1710 will be difficult for many communities because of many factors. Some of the factors related to a community's ability to protect itself includes the combination of the geographical area covered, number of fire stations in the community,

number of fire/EMS vehicles, and the number of fire/EMS personnel. These factors determine how quickly an emergency response vehicle can arrive on scene, how many personnel are on duty on the vehicle to achieve the necessary tasks, and how quickly they can deploy once they are on the scene of the emergency. Therefore, all of these factors must be considered by professional fire departments as they formulate their response to apply their risk reduction methodologies to implement the standard. Tulsa, Oklahoma, an internationally accredited professional fire department, is in the process of developing a response to the requirements of the standard. The standard also provides opportunities to evaluate current service delivery mechanisms.

Tulsa, Oklahoma has been taking the opportunity to evaluate their service deliveries to the citizens of Tulsa for many years. The city is well known for strategic and operational planning in the area of Flood Control. Tulsa has been a leader in the Disaster Management field and has received many awards from the Federal Emergency Management Agency (FEMA). At the same time, Tulsa has also been a leader in the area of strategic and operational planning for the Tulsa Fire Department (TFD).

Former Fire Chief Tom Baker capitalized on the opportunity to lead TFD into strategic and operational planning. His efforts culminated in TFD becoming internationally accredited by the Congress on Fire Accreditation International (CFAI). Current Fire Chief Allen LaCroix seized the opportunity for TFD to become a research laboratory in order to determine the need for risk reduction methodologies for TFD to comply with NFPA 1710. Chief LaCroix, TFD, and other Metropolitan Fire Departments (METRO) are actively engaged in the continual assessment of their performance. Therefore, TFD

and METRO are evaluating their performance in relation to 1710.

Chief LaCroix approved the initial evaluation of TFD for compliance with 1710. This author, members of TFD, and other colleagues identified three main areas of the standard for closer evaluation. The areas of the standard selected for further investigation include response times, staffing, and deployment. Therefore, Chief LaCroix approved an applied research project to more accurately determine the need for change in the three subject areas.

These three areas of 1710 were selected because the initial evaluation performed for the study indicated TFD might not meet the standard in these areas. This project is important to TFD and other METRO agencies because of increased challenges to reduce and manage the risk associated with fire, man-made disasters, natural disasters, and terrorism incidents. This needs assessment offers TFD and other METRO communities an evaluation tool to assist them in determining their compliance with 1710.

Tulsa, Oklahoma is fortunate to have an internationally accredited fire department. International accreditation means the Tulsa Fire Department (TFD) uses strategic formulation of cutting-edge operational plans designed to deliver high-quality essential services to its citizens. The essential services have expanded to include terrorism response due to the terrorist events of September 11, 2001 (9/11). Additionally, 9/11 increased the pressure on TFD and other METRO agencies and emergency service providers to be "prepared" to deal with every day disasters, emergencies, and terrorist acts. These expanded service delivery requirements are producing additional strain on

public safety organizations to provide protection within tight budgets and increased danger. The increased danger challenges all Americans to look inside themselves and find the resolve to recover from the devastating results of 9/11. It is going to be difficult because the additional pressure from 9/11 and already tight budgets have city leaders calling for "thinking out of the box" (LaFortune, 2002). However, NFPA 1710 provides community leaders with a significant opportunity to think out of the box.

The full name of the standard is NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, 2001 Edition. The standard addresses the protection of lives, property, ecosystems, and the environment in the 21st century. It quantifies for the "paid career department" guidelines and performance objectives for initial response times and staffing. These guidelines, or industry "standard of care" objectives are not mandatory for communities to adopt or implement. However, as with all industry standards, they work their way into litigation through "expert" testimony (Lawler, May 15, 2000 personal communication).

Professional fire departments will be judged in their adherence of the standard as they have been for other NFPA standards. The question to answer for organizations and communities like Tulsa is, "do we adopt, implement, or litigate?" Adoption becomes all-inclusive in totality. Implementation of the standard is progressive, and can be accomplished in segments over time. Litigate refers to the perceived legal challenges from interest groups and individuals for perceived "breach of care" for communities that choose not to adopt, or implement. These issues raise the question of, "what are the

impacts of action or inaction?"

Tulsa is actively engaged in investigating, and evaluating their implementation options and capabilities to provide the necessary information for the TFD in order to quantify significant correlation, and implementation alternatives. Hence, the purpose of this project was to determine the need for the implementation of 1710 in the TFD.

Statement of Purpose

The purpose of this project was to determine the need for TFD to adopt risk reduction methodologies to comply with the National Fire Protection Association (NFPA) standard 1710. The areas selected for analysis were portions of Chapter 4 and Chapter 5 of the standard. The project was conducted in Tulsa from January 1997 until December 2002. The determination of the need for TFD to adopt risk reduction methodologies to comply with the National Fire Protection Association (NFPA) standard 1710 will have implementation implications for other METRO Departments. It also has implications for non-METRO Departments.

Research Hypotheses

The research hypothesis for the project stated there is a need for TFD to adopt risk reduction methodologies to comply with the National Fire Protection Association (NFPA) standard 1710. The null hypothesis for the project stated there is no need for TFD to adopt risk reduction methodologies to comply with the National Fire Protection Association (NFPA) standard 1710. The process used to test the hypotheses included the

DCB/1710/GAP analysis tool developed by the author.

A department meeting all of the requirements of the selected portions of 1710 would score a 100 on the Compliance Scale (CS) of the DCB/1710/GAP. Any score less than a 100 indicates a "Gap" in the department's compliance with the standard. The methodology for the study is explained in Chapter 3, the results of the analysis and statistical tests are provided in Chapter 4, and a summary of the findings are in Chapter 5 of this study.

Scope of the Project

This research specifically determined the need for TFD to adopt risk reduction methodologies to comply with selected portions of Chapter 4 and Chapter 5 of 1710. The study analyzed current TFD Strategic Plans, TFD Operational Plans, the TFD report to the Commission on Fire Accreditation International (CFAI), the TFD Resource Allocation Studies, and TFD response data. These internal documents are referred to in this project as TFD Studies. This research includes a GAP analysis between 1710 and current TFD Studies. The GAP Analysis looks at the TFD Studies and 1710 side by side in order to determine areas where TFD meets, or exceeds the Standard. The areas where TFD does not meet 1710 are identified as GAPS. Therefore, the assessment provides the organization with the information necessary to overcome the GAPS.

This project was conducted for TFD. It did not address smaller departments, volunteer departments, combination departments, or any other department. The model specifically addresses the compliance of selected portions of Chapter 4 and Chapter 5 of NFPA 1710

for the TFD, a METRO Fire Department.

History and Background of the Problem

Tulsa Fire Department serves the City of Tulsa, an area of 207 square miles with a population of 400,000. TFD, which is a METRO Department, has 728 employees. The TFD personnel include a combined general and command staff of 89. There are 684 sworn positions in the TFD. Sworn positions have legal authority, responsibility, and state pension benefits. They also have the right to belong to the Tulsa Fire Fighters Local 176 of the International Association of Fire Fighters and are compelled to abide by contract with the City of Tulsa. All sworn personnel have passed rigorous physical, psychological, and technical examinations. They must also maintain their required certifications including CPR (cardiopulmonary resuscitation), Hazardous Materials, Safety, Bloodborne Pathogens, and Hearing Conservation.

Non-sworn personnel are not members of the state pension system, are not subject to the provisions of the "contract", and must abide by City of Tulsa Policy and Procedures as distributed by the Human Resources Department. They are members of professional organizations and associations. They are actively involved in maintaining their knowledge, skills, and abilities through seminars, college, and professional meetings.

The organizational structure of the TFD includes a Field Operations Section, Support Services Section, and a Safety Services Section. There are three Platoons that report to the Field Operations Section Chief. The structure allows the TFD to work within the parameters of the Mission Statement and yearly Operational Plan. The fire department's

mission, goals, and objectives are mirrored by the duties of each appropriate section, defined in Sections 104 through 108.51 and 112 through 113 of the Tulsa Fire Department Administrative Operating Procedures (TFD-AOP, 2002).

Protecting life and property have been major responsibilities of fire departments in the United States since the time of Benjamin Franklin. From the early 1700's until the 1970's the fire service focused on these two objectives. From the 1970's, several additional operational objectives have been added to the fire service. These new objectives include Emergency Medical Service, Hazardous Waste Operations, and Response to Terrorism. Emergency Medical Service became a third objective for the Houston, Texas Fire Department in 1972.

This gave Houston the additional responsibilities of providing first responders to medical emergencies, advanced life support capability, and transport. Departments across the United States soon chose to follow Houston's lead. The fire service was the natural choice to provide emergency medical service because it had strategically placed fire stations, it had response apparatus, and it had competent personnel trained in response. Additional medical training and basic medical equipment put the fire service in the medical service. Things would change again in 1985 to put additional responsibilities on the fire service.

The passage of 29 CFR 1910.120 Hazardous Waste Operations (HAZWOPER) in 1985 put fire departments in the business of protecting the environment. Hazardous Material (HazMat) response is a part of the HAZWOPER regulation. The regulation requires

organizations that respond to hazardous materials emergencies to use an incident management system, chemical inventory lists, and HazMat teams with training at the awareness, operations, technical, and specialist levels. The goal of HAZWOPER is to prevent and/or reduce the impact of chemical release on the environment. Fifteen years after HAZWOPER the wildfires of the late 20th century brought another challenge to fire departments.

The fires in Yellowstone National Park in the 1990's have sparked lively debate for many years. There has been considerable discussion about the positives and negatives of the "let nature takes its course" philosophy. Then the "Los Alamos" fire of 2000 rekindled the debate. The result of these and other significant "wildfires" has been to provide additional training and responsibility to local fire departments in order to preserve and protect ecosystems. Still yet, other changes of global importance would occur on 9/11.

On a clear September morning, on the East Coast of America, two hijacked aircraft rammed into the World Trade Center Towers in New York City on the morning of September 11, 2001 at approximately 9:00 in the morning. Minutes later both towers, over 1300 feet tall, came crashing to the ground while the whole world watched in disbelief. At the same time, a hijacked plane struck the Pentagon building in Washington, D.C., almost penetrating completely through its corridors. Meanwhile, another hijacked plane crashed to the ground in Pennsylvania. The terrorist Osama Bin Laden is credited with planning all four events. President George W. Bush shortly thereafter announced to the world that the United States had declared war on terrorism. Reports from national news media put the death toll of New York firefighters at 343 as of

November 13, 2001.

The events of 9/11 have changed the world forever. Fire Departments of the United States of America are rising to the challenges made painfully evident by the tragic events of 9/11. These events, along with all of the other duties that are performed by the Fire Service, provide a significant challenge for communities to consider in their service delivery methodologies. NFPA 1710 can help meet these challenges. TFD, under the leadership of Chief C. Allen LaCroix is committed to implementing 1710 to help meet those challenges.

Definition of Terms

ANSI-American National Standards Institute

CFAI-Congress of Fire Accreditation International

Ecosystems-Flora, Fauna, Species, Populations, Habitat and the interrelationships.

Environment-Air, Water, and Soil.

IAFC-The International Association of Fire Chiefs. A professional organization designed to assist chief officers in the management of fire departments.

IAFC-International Association of Fire Chiefs

IFSAC-International Fire Service Accreditation Congress

IAFF-The International Association of Fire Fighters. An AFL-CIO organization representing unionized firefighters in the world.

ISO-Standards of International Organization

Lives-Persons, and other living things.

METRO- Over 200 cities (including Tulsa) operate Metropolitan Fire Departments. These departments protect communities of 100,000 population, and/or employ 400 career firefighters.

Model-A way to accomplish tasks.

NFA-National Fire Academy

NFPA-The National Fire Protection Association. A consensus organization tasked with developing international standards for safe building design, electrical codes, fire codes, and educating the fire service. The standards can have precedent setting effect of law.

NFPA 1710-The full name of the standard is NFPA *1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, 2001 Edition.* The standard addresses the protection of lives, property, ecosystems, and the environment in the 21st century. It quantifies for the "paid career department" guidelines and performance objectives for initial response times and staffing

Politics-The allocation of value.

Professional Firefighter-A person sworn to protect lives, property, ecosystems, and the environment. Usually a public employee.

Property-Tangible items like wood and paper. Also, includes non-tangible items such as business activities.

Terrorist-A person who commits or conspires to commit a terrorist act.

Terrorist Act- The result of a terrorist's action. Usually intended to disturb, frighten, disrupt, humble, and kill. States, groups, or individuals can commit acts of terror.

USFA-United States Fire Administration

Chapter 2 –Literature Review

NFPA 1710 is the outgrowth of serious debate concerning scholarly research in the area of risk reduction and fire service standards. This literature review provides perspectives that are useful in understanding the paradigms associated with risk reduction methodologies and the use of national consensus standards in the fire service.

Standardized Fire Service Risk Reduction Methodologies

How do we know our fire companies and ambulances will be there to help us? Additionally, how do we know they will be there in the proper amount of time, with the proper amount of personnel, equipped with the appropriate tools and equipment, and trained to acceptable levels of performance? Furthermore, what standards apply to the fire service? Do the standards make a difference? The answers to these questions and others are contained in this literature review.

The Impacts of Fire Service Standardization

The only way we can know the answer to these questions and how standards impact the fire service is to plan appropriately, and evaluate as necessary. Patrick Below says we must plan, and we must evaluate the impact of those plans (Below, 1987). Using NFPA standards in the United States (US) Fire Service requires planning and evaluation procedures and processes. Program evaluation helps to identify where TFD needs its stations, trucks, and personnel (TFD-RAS, 2000). Performance of the organization's plans must be evaluated.

The Fire Service needs sound policy. Harry Hatry defines performance evaluation as the use of performance information to affect programs, policies or any other organization actions aimed at maximizing the benefits of public services (Hatry, 2002). Hatry is saying that sound policy comes from sound performance evaluation. Bruce Spitz and Grant Ritter (2002) say that a community partnership with a common vision, strong governance, and effective management is more likely to succeed than one that lacks that vision, governance, and management. Implementing NFPA 1710 will require a very strong commitment from policy makers and stakeholders. Hatry, Spitz, and Ritter all maintain that effective public policy requires vision, cooperation, and effective management. Additionally, Julnes and Holzer found that "policy adoption is driven more heavily by factors from rational and technocratic theory, whereas actual implementation is influenced by factors addressed by political and cultural considerations" (Julnes and Holzer, 2001). Modern fire departments must consider effective program evaluation and performance measurement. They must also review their policy to make sure it is appropriate and addresses the intended needs.

Evert Vedung said, "Citizens and elected officials have legitimate reasons to ascertain whether policy goals have in fact materialized in the field" (Vedung, 1999). In other words we have a right to know how our money is being spent, and if it is accomplishing the goals of the program or project for which it was intended. NFPA 1710 was promulgated after considerable dialogue between numerous policy makers and stakeholders spanning over twenty years (IAFF, 2002). This lengthy dialogue is evidence of the high concern of the numerous parties to ensure a standard that is appropriate for the

21st century fire service. The constituents want to know that their government is working (Osborne and Gaebler, 1992). Furthermore, Roger Congleton says, "Moreover, terrorism and ordinary interest-group politics have normative similarities. In both cases, the direct participants in the conflict over the public policy bear costs. All politically active groups employ scarce resources in order to induce or avoid certain changes in public policy (Congleton, 2002). Vedung, Osborne, Gaebler, and Congleton all maintain the public has a right to expect that policies are managed efficiently and effectively. Therefore, modern fire departments must also perform efficiently and effectively.

Implementing Fire Service Standards

Modern fire departments must do at least five things to meet the response, staffing, and deployment requirements of NFPA 1710 (Brown, 2001). First, they need to know where to locate their stations to assure adequate response times to the incident. TFD uses a risk reduction tool developed by members of the department to determine station location (TFD-RAS, 2000). In other words they must use modern risk reduction techniques (NFA, 2002).

Second, they need to have enough personnel to adequately staff the apparatus. TFD uses a risk reduction tool developed by members of the department to determine staffing levels (TFD-RAS, 2000). The NFPA and NFA have conducted numerous staffing studies indicating the need for at least four and as many as six personnel per fire unit (IAFC, 2001).

Third, they need to have adequate resources to fulfill the objectives of ICS in a timely manner (TFD-EOP, 2000). TFD uses a risk reduction tool developed by members of the department to determine deployment objectives (TFD-RAS, 2000). Any incident that does not utilize an incident management system with a high priority on safety is a catastrophe waiting to happen (Brown, 2002).

Fourth, modern fire departments need timely notification of the need for service to assure proper customer service outcomes (NFPA, 2002). Additionally, time is of the essence for emergency response (Brown, Brooks, and Kirtley, 2002). Any time saved during dispatch or call processing equates to increased probability of a successful incident (NFPA-1221, 2002).

Finally, modern fire departments need to adopt and implement a response, staffing, and deployment standard (IAFC, 2001). TFD has committed to implement NFPA 1710. This standard provides the most applicable guidance for the 21st century fire department in America (IAFC, 2001). Proper response, staffing, and deployment processes will reduce loss of life, reduce civilian and firefighter injuries, increase survivability of cardiac arrests, reduce property loss, reduce environmental damage, and reduce actuarial loss to insurance companies. These benefits will convert to lower insurance costs and thereby provide more disposable income for the consumer. More disposable income for the consumer will stimulate purchasing or savings. Stimulating purchasing will increase tax collection, and thereby increase community general funds for services. Stimulating savings will increase the money supply, and thereby increase borrowing. Increased borrowing leads to purchasing which leads to increased tax collections for the general

fund (Wiedenbaum, 1995). All of these situations will help improve the funding and support for the modern cutting-edge fire department (Brown, 2002).

Characteristics of a Modern Fire Service

TFD epitomizes several key characteristics of a modern cutting-edge fire department. All organizations must have commitment and policy. "An organization should focus on what needs to be done-it should ensure commitment to the environmental management (or fire service) system and define its policy" (Sayre, 1996). Implementing NFPA 1710 in TFD will require top management approval and support. This commitment should begin at the top and is the safest and least expensive way for organizations to survive. This helps the organization comply with regulations, limits liability, and makes the usage of resources more efficient (Sayre, 1996). In the fire service we should also emphasize the need for more efficient, effective service. According to Gary Marrs, retired Fire Chief of the Oklahoma City, Oklahoma Fire Department we have fire trucks and fire stations in order to save lives and property; that is, our job is to manage risks (Marrs, 1998). TFD is planning and preparing to implement NFPA 1710.

Planning to Succeed

All organizations must plan (Below, 1996). This principle encourages an "umbrella" type of organization-wide management system that is supported by individual work plans related to specific activities. Work processes should be performed according to pre-planned procedures. The design, construction, and operation of all activities must be pre-planned to maximize efficiency and effectiveness. All organizations must implement

their planning and policies. "For effective implementation an organization should develop the capabilities and support mechanisms necessary to achieve its ... policy, objectives, and targets" (Sayre, 1996). Sayre also said, an effective management system in an organization must ensure management capability, know what resources are needed, align and integrate management systems, assign responsibilities and accountability, encourage organizational management values, assure know-how and competence, support the management system, handle communications, handle documentation, handle information and records, control the management system, and continue to prepare and respond to emergencies.

The actual success of organizational projects and programs depends largely on how well they were implemented (NFPA, 1988). All organizations must measure and evaluate their performance. "An organization should measure, monitor, and evaluate its ... performance" (Sayre, 1996). The author maintains that "measuring, monitoring, and evaluating ongoing performance are essential to understanding whether an organization is complying with {self} imposed requirements and if it is successfully pursuing its environmental objectives and attaining environmental targets" (Sayre, 1996). TFD evaluates its performance on an annual, monthly, weekly, and daily basis (TFD, 2001).

Additionally the organization must conduct audits by internal or external personnel in order to determine the organization's compliance with its self-imposed management system. This will provide management with information relative to any changes that may be necessary for organizational improvement. According to the authors of Practical Program Evaluation for State and Local Governments, "Rarely are a single program

objective and a single evaluation criterion sufficient to describe the impacts of a program", (Hatry, Winnie, & Fisk, 1981). The authors maintain that no one measurement or evaluation technique is appropriate. On the contrary, they emphasize that a variety of techniques and procedures must be used to increase the probability of accurate evaluation. And, since decisions need to be based on the best information available at the time, organizations (and especially METRO FD) need to have the best information possible. TFD seeks, embraces, and encourages third party analysis of its operations. All organizations need review and improvement. Steps must be taken to continually improve the organization by addressing the root of the problems. Deming maintains that organizations should continually strive to improve the quality of their performance (Deming, 1972). Sahskin and Kiser, in their book Putting Total Quality Management to Work maintain that organizations must continually review the system at appropriate intervals to ensure its continuing suitability and effectiveness (Sashkin and Kiser, 1993). Additionally they say to document the audit and review findings in order to determine the root cause of the non-compliance (Sashkin and Kiser, 1993).

According to Dr. Mike Hirlinger, Director of Public Administration Programs University of West Georgia, "Political leaders, public administrators, and the public need as much information as possible in order to make intelligent choices" (Hirlinger, personal communication May 15, 1999). Accurate information, intelligent choices, and a constant review of the organization's performance will provide the basis for positive incremental change (Deming, 1972). However, Deming wanted people to focus more on the organization's culture and philosophy of management whereas Osborne and Gaebler

(1992) want people to "reinvent government". That is, they suggest for those of us in government to think outside of the box if we want to succeed. However, we must also remember to work within the box until we have the authority to expand the parameters of the box (Brown, 2001). It is essential for leaders to understand the challenges of the organization in order to succeed in their mission.

Challenges of Standardizing the Fire Service

The United States Fire Service has been challenged for many years according to America Burning Revisited (USFA, 1987). "There are some terrible and terrifying scenes...many, many fire departments still allocate less than one percent of their resources to fire prevention efforts" (USFA, 1987). That means ninety-nine percent of staffing is in response, as opposed to mitigation. However, fire is not all that the 21st century fire service is expected to manage. The 21st century fire service has become the first responder to citizen medical emergencies over eighty percent of the time (Brown, 2001). But, they must continue to deal with fire.

Consider the 1947 report entitled, President's Fire Prevention Conference of 1947. The President of the United States, Harry S. Truman, believed that fire was enough of an issue in America to convene the best minds in the country to identify ways to prevent unwanted fires. They also are credited with the identification of "the 3 Es" relating to fire prevention (Engineering, Education, and Enforcement), the latter really underscoring the report's overall importance. Mr. Azarang (Ozzie) Mirkhah, P.E., EFO, Fire Protection Engineer, of Las Vegas, Nevada Fire & Rescue spent many months researching and

preparing the 1947 material for use by others.

Additionally consider the "President's Report on Fire in America" commissioned by President Harry S. Truman indicated $ 500 million dollar loss per year, and 10,000 fire deaths per year (Truman, 1947). Then, consider the 1973 USFA report entitled, "America Burning". This document reported $11 billion dollar loss per year, 12,000 fire deaths per year, and 175 firefighter deaths for 1971 (USFA, 1973). Finally, compare the U.S. losses from 1947 to 2000 adjusted for population to get a picture of what the fire problem in America is doing. Readers will see that fire in the U.S. still results in the loss of over 5,000 persons annually, more than 12 Billion American dollars in property loss, and over 100 firefighter's deaths due to Fire. Just one fire in 2000, the Los Alamos Fire, cost Americans over 1 Billion dollars alone. Then, add in the "other" annual fire losses for nearly 12 Billion dollars in total property loss due to fire in 2000 to get a picture of the current fire and risk reduction problem (USFA, 2002).

The Current Fire and Risk Reduction Problem

Risk reduction in the 21st century fire service is a combination of the past, the present, and the future. The past must be remembered because of the successes and the failures. The present must have attention because of the ever-present danger of man-made and natural disasters. Finally, the future requires attention because of the "new age of terrorism" according to Dr. Bill Parle, Professor of Political Science, Oklahoma State University (Parle, personal communication October15, 2001). Risk reduction for the 21st century involves defining the parameters, preparing the personnel, and determining the

appropriate standards of conduct. According to Dr. Jim Lawler JD, Ph.D. standards of conduct apply to "professions" whether all of the professionals adopt them or not (Lawler, personal communication July 2000).

According to David Paulison, Director of the United States Fire Administration America's fire death rate is one of the highest per capita in the industrialized world killing over 4,000 people, injuring more than 22,000 people, and killing more than 100 firefighters each year. The direct property losses due to fire exceed $11 billion a year (USFA, 2002). The U.S. Fire Administration through the National Fire Academy teaches that greater safety is achieved through education, engineering, and enforcement (NFA, 2002). There are also many regulations affecting the fire service. The Code of Federal Regulations (CFR) contains many regulations that have the impact of law. That is, they are not optional and do have penalty for non-compliance (OSHA, 2002). Additionally, fire fighters are finding themselves in the middle of the time-temperature curve (flashover conditions) during fire fighting, and post-cardiac survival windows because of various time elements required for response and staffing.

The Criticality of Standardized Response Times, Staffing, and Deployment

Time is of the essence in emergency response (Brown, 2002). NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, 1999 edition requires handling of an emergency request for service within 60 seconds (NFPA, 1999). EMS response beyond five minutes has negative impact on patient survivability (Anderson, 1997). In fact, the American Heart Association has documented

case studies where early defibrillations from two Advanced Cardiac Life Support (ACLS) providers and two Basic Life Support (BLS) providers at the scene within 6 minutes provide cardiac arrest survival rates higher than 20% (AHA, 2000). Furthermore, J. P. Pell concluded that reducing response times to five minutes or less can double the survival rate for cardiac arrest (Pell, 2001). Systems that average less than four persons per unit can not deliver care to meet AHA guidelines. Likewise, fire response greater than five minutes increases the danger to firefighters and occupants exponentially due to the time-temperature curve (NFPA, 2002). Therefore, adequate staffing is critical to fire fighter survival.

Numerous studies exist documenting the need for adequate staffing on the fire ground (IAFF, 2002). Cities like Dallas, Texas, Boston, Massachusetts, Houston, Texas, Chicago, Illinois, and Tulsa, Oklahoma have all conducted staffing analyses (IAFF, 2002). Each study points out the need for four to six persons at a minimum on fire trucks. The NIOSH publishes detailed reports on a weekly basis dealing with fire fighter death. Rarely does a report ***not*** indicate a staffing deficiency as a cause, or contributing cause of fire fighter death. Additionally, insufficient staffing contributes significantly to increased loss of life, increased injury, and increased property loss for the public (Brown, 2001). Furthermore, adequate response times, adequate staffing, and adherence to nationally recognized standards, laws, and regulations will allow the implementation of Rapid Intervention Crews in a timely manner to protect fire fighter safety and health (IAFF, 2002).

Determining the Impacts of Standardization

The National Fire Protection Association is the standards making body for the United States (US) fire service (NFPA, 2002). The purpose of NFPA is to reduce risk (NFPA, 2002). The passage of 1710 in Anaheim, California in May of 2001 catapulted the US fire service closer to a national risk reduction model (IAFC, 2001). The promulgation of this standard was the output of over fifty years of scientific research regarding the behavior of fire and the expected response of fire fighters and emergency personnel (USFA, 2002). The expected response, which is based on NFPA standards (and other laws and regulations), is exemplified in recent court cases citing a failure to deliver the appropriate standard of care (IAFF, 2002). This failure, or breach is increasing litigation exposure for cities, fire officers, and emergency responders (Scheid, 1997). Many organizations are "standard uninformed" according to Brown (Brown, 2002). Dr. James Lawler indicates that the aforementioned professionals are held to a "standard of conduct" whether they formally adopt a consensus standard formally, or informally (Lawler personal communication, July 2000.). That is, professionals have a duty to act (Scheid, 1997). Therefore, the need to have a consistent risk reduction deployment model is being exacerbated by the failure to adequately reduce risk (USFA, 2002).

Bridging the Past, Current, and Future of Fire Service Risk Reduction

The predominant risk reduction theory in the past was response (NFPA, 1975). The NFPA book entitled "Fire in America" indicates that over two hundred years of fire risk management basically points out that Fire Chiefs expected Firefighters to, "put the wet

stuff on the red stuff" (Brown, 2001). Standards for risk reduction really did not come in to play until the 20th century (NFPA, 1975). One of the first risk reduction models was the theory that if firefighters could get water on the fire it would go out. The method of application began with buckets of water drawn from horse troughs. Later, the theory was to provide underground wooden water pipes. When firefighters needed water from the wooden water mains they would dig down to the main and drill a hole through the wood. Firefighters could then use the water in the wooden mains for extinguishment of the fire. Afterwards, to shut off the water firefighters drove a plug into the hole of the "main". This "fire plug" allowed the "risk managers" to access the water for the next fire. These examples are indicators that the American Fire Service theoretical approach from 1850 to 1950 continued to focus more and more on engineering and response (NFPA, 1975). The focus on response did not end disasters or major conflagrations like the Great Chicago Fire. However, a growing population and new combustible materials forced the fire service to adopt more modern risk management techniques.

Recent Fire Service Risk Reduction

The first course offered at the National Fire Academy in 1980 was a risk management course for the fire service (NFA, 1996). Fire Service Risk Management is the evaluation or comparison of risks and the development of approaches that change the probability or the consequences of a harmful action (NFA, 1996). Additionally, Funk and Wagnall define risk as the chance of injury, damage, or loss (Funk and Wagnall, 1981). Furthermore, the basic mission for all fire service agencies is protecting life and property (USFA, 2002). Therefore, risk management is not a new concept for the fire service.

Additionally, Coleen Vogel defined risk as the expected loss of lives or property caused by a particular phenomenon (Vogel, 1998). She went on to say in her article "Disaster Management in South Africa" that risk usually depends on the combination of the frequency and severity of the hazard and the vulnerability of the people exposed to it. In other words, risk = frequency times severity times vulnerability. Therefore, she describes communities, physical infrastructure, services or activities as elements of risk. She also indicated that perceptions of risk are very complex and are a product of history, politics, socio-economic conditions, and institutional practice (Vogel, 1998). This is echoed by the NFA Risk Management in the Fire Service course (NFA, 1996). Both Vogel and NFA see disaster as risk that was poorly managed, or not managed at all. Additionally, they indicate the need for a comprehensive risk management program. The 21st century fire service model of risk reduction includes standardization (IAFC, 2001).

Comprehensive Fire Service Risk Management

According to Kurt Darr a comprehensive risk management program includes identifying, controlling, and financing risks of all types (Darr, 1999). Additionally, all risk management programs should prevent, reduce, and minimize the effects of risk. Darr, Brown, NFA all maintain that to manage risk you must identify, evaluate, eliminate, reduce, and transfer risk. This study indicates the need for standardized four-minute response times for initial EMS and Fire calls. Furthermore, it requires standardized eight-minute response times for the complete assignment of fire units, or Advanced Life Support Units. Notwithstanding, is the standardized provision of a Rapid Intervention Crew on the initial assignment ready for immediate deployment of fire fighter rescue

with four person minimum staffing (NFPA, 2001). These requirements are based on years of research from agencies such as National Institute of Occupational Safety and Health, American National Standards Institute, International Association of Fire Chiefs, and the International Association of Fire Fighters (IAFC, 2001). NFPA 1710 is the most significant fire service risk reduction standard to be promulgated in the last one hundred years (IAFF, 2002).

Managing risk is more than just identifying it, or responding to it. Placing fire and EMS apparatus throughout a community takes considerable thought, planning, and cooperation (TFD-RAS, 2000). Darr maintains that these actions actually help eliminate, reduce, and transfer the risks (Darr, 1999). However, it is not always a simple task. Dr. Will Focht found that the underlying premise of Not In My Back Yard (NIMBY) is due to citizens' perceived political illegitimacy of decision making institutions (Focht, 1995). The City of Tulsa, Oklahoma also found out recently that not everyone wants a fire station in their neighborhood (TFD-RAS, 2000). The neighbors did not equate the cost of the risk being managed to being equal to the benefit they would receive from the management of the risk. In other words, they did not associate the increased safety of having an EMS/fire unit seconds away (benefit) with the increased cost on their peace and quiet (liability) of the units responding as a balanced equation. Therefore, even when a standard requires action the risk bearers perceptions must be considered anytime risk is managed (Brown, 2001).

Evaluating Risk Management Programs

All communities must evaluate and manage their risk (NFA, 2002). TFD strives to reduce risk through risk reduction activities in agreement with the risk bearers. The TFD Mission was formulated based on citizen input. Therefore, the TFD Mission, "Protect community life, health, property, and the environment by delivering quality life and fire safety services" is a community driven mission. Additionally, this makes it a stakeholder, or risk bearer driven mission as well (TFD, 2001). The key here is in concert ***with*** the risk bearers, not ***for*** the risk bearers. Managing risk ***with*** instead of ***for*** yields a quality situation for all parties. As said before, all communities must evaluate and manage their risk (NFA, 2002). NFPA 1710 provides a methodology to standardize risk reduction in the professional fire service by providing verifiable measures of the standards impact (IAFF, 2002).

Hatry, Winnie, and Fisk maintain that program evaluation's chief focus is on measuring a program's impact. That is, the evaluation is retrospective in that it evaluates how things have changed over time (Hatry, Winnie, and Fisk, 1981). As said earlier, before risk can be reduced it must be assessed, or evaluated. There are many ways to reduce risk according to Dr. Will Focht of Oklahoma State University. Focht says, "Risk managers understand that most people are risk averse and that there is no such thing as zero risk. There are many models of risk, risk compliance is preferred by the Environmental Protection Agency (EPA), the public prefers risk avoidance, and industry prefers risk-based decision-making (Focht, personal communication July 2000). However, most people believe risks they can control are lower risks (NFA, 1996). Also, one has to ask

what level of risk is acceptable. Many people know that risk is an uncertain probability of an adverse occurrence. But, we still smoke, drink, eat fat foods, and drive vehicles that pollute our air, pour chemicals into our water, and deplete our natural resources. Hatry and colleagues say that the purpose of measuring, assessing, or evaluating a public program is to determine the positive and negative impacts. They indicate that this evaluation is what helps people (and politicians) make informed decisions to continue, modify, or terminate programs such as NFPA 1710.

TFD is on a mission to provide essential services in a continuously improving delivery process. Part of the process involves identification of risk bearers, stakeholders, and risk managers (Focht, 2000). Risk bearers include persons who are aware of the risk, and those who are not aware of the risk. Stakeholders include all parties related to the risk. These parties include risk bearers, risk producers, risk managers, and risk reducers (Focht, 2000). The fire service has been challenged with incorporating risk management into their operations for years.

Incorporating Risk Reduction Standards in the 21st Century Fire Service

Murrey Loflin and Jonathan D. Kipp (1997) point out in "Incorporating Risk Management into Emergency Incident Operations" that the current edition of NFPA 1500 calls for each fire department to implement a risk management program. They say that the program must address all activities--administration, training, vehicle operation, protective clothing and equipment, facilities, and operations at emergency and non-emergency incidents. Furthermore, they say that rather than being stand-alone events,

safety and risk management must become part of the organization's foundation. District Fire Chief Don Grant found the same conclusion in his Downtown Tulsa Target Hazard Project (Grant, 1994).

Grant developed a process to increase the awareness of "target hazards" for the personnel in the downtown area of Tulsa, Oklahoma. His applied research project for Southern Nazarene University in Tulsa, Oklahoma allowed the members of TFD to enjoy the "luxury" of having up-to-date information on the city's highest life hazard occupancies (Grant, 1994). This project was significant because of the infancy of computers, scanners, and computer aided graphics programs. Chief Grant, along with the members of District 1-C Platoon, was able to convert hand drawn diagrams into digital images. He then was able to motivate the firefighters of his District to participate in reducing their risk by assisting him in "redrawing" the images using standard Windows™ software in order to provide up to date information for known target hazards. This was revolutionary for the time. All fire companies in TFD were provided a finished copy of the Downtown Tulsa Target Hazard Manual, and received the appropriate training to use the life-saving device. The manual is still in use today and is a vital part of incident management.

Therefore, Grant was applying the methodology of the NFA, and NFPA in 1994 ***before*** it was written into a course in 1996 (NFA, 1996). Chief Grant epitomizes the proactive risk manager. To be proactive, risk managers must identify, assess, communicate, and reduce risk. NFPA 1710 helps fire officers be proactive in their efforts to reduce their risk.

Proactive Fire Service Risk Reduction

The risk manager uses risk reduction techniques to more effectively manage the risk (Scanlon, 1986). Therefore, the 21st century fire officer will be proactive in his/her use of nationally recognized standards of care designed to reduce risk. Risk reducers design, develop, evaluate, and recommend alternative methods of managing risk (like the Grant project). According to the IAFC, METRO FD agencies similar to TFD use the same basic process in risk reduction (IAFC, 2001). Identifying the risk is important because people need to know they are at risk before they can do something about it according to Scanlon (1986). Likewise, it would be unfair to ask citizens for additional taxes without explaining the costs and benefits of the proposed program. Scanlon also said risks are qualitatively and quantitatively undefined in the private and public sectors (Scanlon, 1986). He submits that there are two methods discussed to improve the situation: Risk Assessment, and Legislation (the Hazardous Materials Transportation Act). In other words, Scanlon advocates risk management techniques coupled with laws, regulations, or standards.

Scanlon says the HMTA of 1974 gave the Department of Transportation regulatory authority over hazardous material transportation in interstate commerce (Scanlon, 1996). The HMTA provides instruction for the storage, shipment, and transfer of hazardous materials (risks) within communities and states. The act provides TFD with regulatory authority of major risks within their jurisdiction based on standards, laws, and regulations. Therefore, these risks are a significant variable in the determination of the logistical allocation of departmental resources (TFD-RAS, 2000). The logistical

allocation of departmental resources has been based on existing NFPA standards which focus on risk identification, probability, severity, assessment, communication, and management (TFD-RAS, 2000).

Identifying the Risk

Identifying risk involves quantifying and qualifying the hazard (Scanlon, 1986). This identification is based on standard risk assessment techniques. Previously only the highest-ranking government and industry officials were allowed to discuss critical issue questions regarding the manufacture, use, storage, transportation, regulations, and response to Hazardous Materials. However, now this is taking place at the community level through Local Emergency Planning Committees. The LEPC in Tulsa uses an all-hazards approach to identify, quantify, and qualify the risks for Tulsa County (McCool, 2000).

The Probability of Risk

According to Scanlon over 4 billion tons of the 2400 substances listed in CFR 49 are shipped annually in the United States in over 100 million shipments. These shipments include poisons, explosives, corrosives, flammables, and compressed gases that could injure or kill thousands of citizens, destroy ecosystems, and cause irreparable harm to the environment (Brown, 2000). Therefore, it is rational to expect communities to prepare for the probability of an accident. NFPA 471 and 472 are hazardous materials response standards that assist communities in being prepared for hazardous materials risks. The concern with Hazardous Materials represents only one area of probability for a

community. Communities must also be prepared for tornadoes, hurricanes, floods, earthquakes, and mudslides (NFA, 2002). However, the probability of such an accident, or risk, is related to the severity of the risk.

The Severity of Risk

The severity of risk is related to the potential of a "catastrophic impact on the community" (Scanlon, 1986). NFA says the severity of risk is related to a harmful or undesirable consequence, and the severity of the harm that might result (NFA, 1996). Frequency refers to how often a community may be exposed to the hazard, or risk. Probability is the relative long run frequency of some event whose physical properties make the exact time of its occurrence or nonoccurrence unknowable (Jablonowski, 2001). Communities must examine their vulnerability in light of their "finite resources" by planning properly for their occurrence. Stakeholders want to know how much risk is really going to affect them personally (Brown, 2001). Therefore, the risk must be properly assessed, and communicated. NFPA 1690 provides a means for communities to preplan for their risks.

Assessing the Risk

Assessing the risk means the risk has not only been identified, but it has also been quantified. Absolute risk assessment is an estimate of the number of persons who might be killed or injured, potential economic loss in dollars, and the potential ecological/environmental loss. Practitioners find the "absolute risk" measures desirable because it gives them a "feel for the condition of safety" of the community (Scanlon,

1986). Risk calculations differ from preparedness assessments in that risk assessments consider alternate routes and corridors, while preparedness deals with a community's ability to deal with a catastrophe. The Federal Emergency Management Agency, United States Fire Administration, National Fire Academy posits that a modern fire officer's job is not to just identify and manage risk; it is to reduce risk (NFA, 2002). Furthermore NFPA 1201 states that a fire officer's job is to reduce risk in their community (NFPA, 2002). Additionally, NFPA 1600 indicates that communities must develop an all hazards risk reduction plan. Overall, a community is concerned with two issues: 1) the degree of hazard and 2) the need for improvement to deal with the hazard appropriately (McCool, 2000). Both require adequate risk communication.

Communicating the Risk

Communication of risk involves identification and planning. Planning is essential to effectively deal with the risk, or "vulnerability" of communities to the "catastrophic impact" of an incident involving the unexpected release of chemicals or the occurrence of a natural disaster. Scanlon calls this the "value of the community process of assessing risk" (Scanlon, 1986). In other words the community must be involved. Likewise, Ortwin Renn believes open dialogue and information sharing programs are important for effective risk reduction policies for communities (Renn, 1992). He says risk assessments are critical to the process, assessing risk involves further analysis of the identified risks, and risk communication is extremely important to risk reduction. He also emphasized open dialogue and sharing in the article "Risk Communication: Towards a Rational Discourse with the Public," (Renn, 1992). He discusses how to "reconcile expertise,

interests, and public preferences". In other words, he explains in great detail how to communicate risk to stakeholders in a rational manner. Renn maintains a rational discourse is needed because sensitivity to health and safety hazards has put risks and environmental quality among the top concerns of the public. NFPA 1500 provides guidance for fire departments to develop a comprehensive risk management plan (NFPA, 1997).

Power politics, economics, and a global marketplace are changing the way people deal with risk according to William Culley (Culley, 1998). Command and control will not work anymore. We want to be informed, not bullied or pushed around. Society is becoming less trustful of experts and people who do not live in our own backyard (Culley, 1998). Therefore, risk communication must involve feelings, perspectives, and beliefs. It cannot just be quantifiable numbers and theories (Focht, 2000). True risk communication according to Renn involves listening, and listening, and listening, and listening, and a little bit of talking (Renn, 1992). Too often, the risk communicator wants to do all of the talking. Many times the talk is not what the risk bearers are concerned with at all. That is why risk communicators need to listen to the risk bearers to find out what their concerns are, and then help them identify how much risk they are willing to bear (Renn, 1992). Others share Renn's position.

Covello, Slovic and VonWinterfeldt have defined risk communication as "any purposeful exchange of information about health or environmental risks between interested parties" (Renn, 1992). The overall objective of risk communication is to transfer information with "purpose" to either change behavior, or to provide information about potential

dangers/remedies (Renn, 1992). Renn further categorizes "purpose" by 1) making sure receivers understand the message, 2) persuading receivers to change behavior in light of the message, and 3) providing a "rational discourse" for an effective conflict-resolution process. Source-message-receiver models apply to risk communication as well as other communications. According to Renn,

> Risk communication must address the qualitative characteristics of risk. Therefore, risk communicators must consider the difference in sources of the messages, nature and technology, social amplification of risk, secondary sources of risk communication, the reception of risk information, the role of the transmitters in communication, and the transmitters of risk-related information (Renn, 1992).

Also, Renn says persuading people to change attitudes and behavior depends on the salience of the argument. This implies that a risk communicator has to argue with risk bearers to get his or her point across. Arguing leads to communication breakdown because of emotions, not rational communication. True communication involves a message, a message sender, a medium, a message receiver, and feedback; not arguing. Utilizing more feedback and listening would improve risk communication. A risk communicator engaging in an argument for risk communication encourages a hostile and tense environment. This is not communication, but intimidation. An environment of trust, mutual respect, and empathy on the other hand provides an opportunity for a "rational discourse", instead of a heated argument (Renn, 1992). Consensus building, fact-finding, logic, value acknowledgement, fairness, willingness to learn, equality,

rational thinking, de-moralization, participation impact evaluation, random discourse, and agreement of the rules set the stage for a rational discourse (Renn, 1992).

Risk communication should follow a rational discourse because of the potential disasters that can result from making the wrong choices in risk policies. This potential requires more than "trial and error" risk decisions and policies. "Success in a political arena...is contingent on the availability of social resources" (Renn, 1992.). Dr. Robert England, Director of the Fire and Emergency Management Administration Program of Oklahoma State University, echoes Renn when he says, "Politics is the allocation of value" (England, personal communication May 12, 1998). One should clarify intentions, simplify the message, start out simple and build to complex, match the message to the target, but do not change the message. Be honest, be personal, be prepared, select the right cues for the audience, and be rational and logical.

Risk communicators should place risk in social context, use proper comparisons, and develop trust and credibility. England is a master at communications according to his colleagues. He epitomizes the actions that help address the concerns and interests of the receivers while encouraging open rational discourse to empower all participants to be equal partners in making decisions about risk. Experience of this author has shown that respecting others views while seeking understanding goes a long way in risk communication. In other words, it is hard to have a rational discourse if you are in the middle of an irrational outburst. Implementing NFPA 1710 will certainly require great communication skills. However, even the best risk communication is not adequate if the risk is not managed.

Managing Fire Service Risk

The NFA maintains that METRO risk involves community risk, organizational risk, and operational risk (NFA, 1996). According to NFA,

> Risk is an inherent component of the work emergency responders perform. Their ability to work in an elevated risk environment sets emergency responders apart from the general population. In order to survive, emergency responders must effectively manage their exposure to risk by recognizing danger, considering and weighing alternatives, and balancing anticipated benefits with potential consequences. In some cases, doing that leads to the conclusion that a given situation simply does not justify the risk involved in taking action (NFA, 1996).

Organizational risk includes injury or death to citizens due to traffic accidents, fires, medical emergencies, natural and man-made disasters, and other community disrupting activities. Operational risk refers primarily to the risk of death or injury to firefighters and other emergency responders that could result from the performance of their duties (NFA, 1996). Community risk refers to potential disruptions of community activity such as sporting events, infrastructure damage, education impediments, water supply, and other major community disruptions associated with large-scale disasters.

According to the text Emergency Management: Principles and Practice for Local Government, "The single most crucial aspect of effective emergency management is making sure before a disaster occurs that in a disaster responsibility, authority, and channels of communication are clearly delineated" (ICMA, 1991). The fire service plays

a large role in managing disasters. Disaster management systems seek to prevent or lessen risk.

The whole country is concerned about risk according to H. F. Martz and W. J. Zimmer (1992). They say in their article about the Space Shuttle Challenger booster rocket tragedy that the accident evoked a national resolve to more clearly and accurately determine the risks of space flight and to reduce the risk of future tragedies in general. Risk is everywhere. Luckily, there are many models to help manage risk.

Risk Management Models

Models to manage risk range from comprehensive to national to local models. But, all models use two basic approaches for reducing the impacts of natural disasters. The two models include mitigation and response according to Iwan, Cluff, Kimpel, Kunreuther, Masaki-Schatz, Nigg, Roth, Ryland, Harvey, Ellis, Thomas, Hamilton, Jones, and Parker (1999). Mitigation includes all those actions that are taken before, during, and after the occurrence of a natural event. Response includes those actions that are taken during and immediately after the event to reduce suffering and hasten recovery of the affected population and region (Iwan et al, 1999).

Mitigation also includes avoiding hazards. Iwan and his colleagues indicate communities can build out of a flood plain or away from seismically active faults. They also maintain that mitigation includes warnings for evacuation preceding floods, hurricanes, and tornadoes. It also includes reducing vulnerability through flood proofing of buildings, tornado proof construction, or earthquake resistant buildings

Response on the other hand includes both short-term and long-term actions. Short-term actions include the actions taken by police, fire, and other agencies during the event. Long-term actions include providing for food, shelter, rebuilding, and restoration of the affected community. Iwan maintains that both elements are important in dealing with natural hazards (Iwan et al, 1999). However, response has been practiced more than mitigation until recently.

Protecting the homeland has become the No. 1 job, in President Bush's view according to Thomas Omestad (2001). He maintains that by 2003 federal spending on domestic security will have doubled to more than $37 billion. Additionally, Omestad says, "With state and local governments and the private sector joining in, a total of some $100 billion will flow into domestic security in the first year after 9/11" (Omestad, 2001). Now, because of 9/11 the tempo has picked up as well as the planning for all kinds of disaster, including terrorism. This requires a continuously improving fire service risk reduction effort (USFA, 2002).

Quality Risk Reduction for Disaster and Emergency Management

All disasters require risk assessments. "The purpose of risk assessment is to estimate the probability of occurrence of an adverse effect and the magnitude of consequences" (Bhat, 1998). Risk assessments can focus on financial, environmental, health, or safety risks within the community. Checklists, rough analysis, what if, failure mode analysis, and fault trees can be used to conduct risk analysis. Additionally, organizations use a variety of programs to manage risks. The fire service has a part in all disaster management

systems. The authority having jurisdiction usually decides which model to use for the community. Tradition, familiarity, training, education, and fit help determine model preference. All METRO agencies participate in general disaster planning with a very high level of quality service delivery (IAFC, 2001).

21st Century Disaster Management

Disaster management systems and quality go hand in hand. Emergency and disaster managers work together in a cooperative manner to resolve the incident to a mutually beneficial outcome. All successful organizations have a quality philosophy. W. E. Deming is well known for his fourteen points to improve quality (Deming, 1972). The Deming Prize and the Malcolm Baldridge Award identify attributes for quality organizations such as "managerial leadership, customer focus, employee participation, open corporate culture, fact-based decision making, and cooperation with suppliers for successful implementation of TQM" (Bhat, 1998). Emergency Operation Centers staffed with quality people who can communicate and coordinate with each other to make quality decisions for the community increase the ability of the disaster management system to create quality results. Systems that produce quality results are a win-win situation for everyone (Gale, 1994). Quality planning leads to quality results.

Disaster Planning involves considering events that can disrupt a community's daily operation. Usually, these interruptions cause people to forego their normal daily routines and force them to change their priorities to help them, or others survive. In other words, planning is essential for a good outcome. Organizational theory requires organizations to

set goals and objectives to maximize the utilization of resources. Every organization needs planning. This planning must be accurate, timely, flexible, supportive, and communicated effectively to all stakeholders. The elements of effective disaster planning must include appropriate criteria to encompass "all hazards" that affect the communities and governments they are designed to protect. Managers, responders, politicians, citizens, and other interested parties should develop these plans using effective disaster management tools. Bhat says, "Data collection, histograms, Pareto charts, Ishikawa diagrams, stratification, scatter plots, run charts, flow charts, matrix data analysis, and control charts are some ...tools that can be used to develop alternatives" (Bhat, 1998). Teams use these tools and "affinity diagrams, relation diagrams, matrix diagrams, process decision program charts, and arrow diagrams" to help qualify and quantify what needs to be accomplished in the organization (Bhat, 1998). However, organizations need to know how they compare to other organizations in the same business. That is where benchmarking can help.

Benchmarking involves copying best practices of the competition in order to improve organizational performance. The goal of benchmarking is to identify weaknesses in comparison with companies that excel in a particular function and to take corrective actions to outperform them (Bhat, 1998). The TFD uses benchmarking to help guide the organization's planning function. The information is collected, assimilated, and analyzed. There are principles that must guide organizations too.

Principles for a quality driven effective disaster management plan include top management support, pollution prevention, receptive culture, mission changes, cross-

functional teams, life-cycle approach, organizational restructuring, performance measurement system, full cost accounting, and stakeholder involvement help produce a "formalized management structure to plan, organize, and implement ...programs" (Bhat, 1998). These tools, techniques and concepts help organizations focus on the big picture of risk reduction in the fire service, especially when the Emergency Operations Center (EOC) is activated.

Activating the EOC

The EOC is a vital part of Disaster Management. Quarantelli and Dynes identified eight types of emergency management organizations (Quarantelli & Dynes, 1972). Each type requires management and coordination. The EOC serves as the master coordination and control point for all counter-disaster efforts. The EOC is responsible for coordination, policymaking, operations management, information gathering and record keeping, public information, and hosting visitors. Coordination is the single most important function of the EOC. Quality EOCs provide an atmosphere, climate, and culture conducive to maximizing the coordination activity.

It is interesting to note that according to Dr. Cole Blease Graham, Jr. and Dr. Steven W. Hays (1993) "...placing an inadequately trained or otherwise incapable worker in a job that is too big for the person is an open invitation to disaster." Organization theory, interpersonal communications, systems management, and small group dynamics are areas of growth and development that contribute to quality management. Disasters are not the place for inexperienced, uneducated or poorly trained EOCs. There are just too many

problems to deal with and too many organizations to coordinate. This overwhelms the EOC. Disasters cause additional headaches for Disaster Managers. The convergence of people and materials presents a significant task for EOCs. Quality EOCs can prepare for convergence and other problems by preparing their teams before disaster strikes. Quality training and education help to establish needed Quality EOCs. However, convergence complicates the situation.

Developing Effective EOC Personnel

According to Paul Hersey, Ed.D, Ken Blanchard, Ph.D., and Dewey E. Johnson, Ph.D., (1996), training and retraining keeps people, the most valuable resource, in the organization. For change to come there must be vision. Disasters are no place for improperly trained and inadequately educated decision-makers. A disaster is no place to create additional disasters because of untrained people. However, there must be change to keep this from happening. Disaster managers and Emergency Operation Center managers need a vision in order to see the need for change. Academia, responders, managers, victims, and other stakeholders can communicate this vision. Then true change can begin to take place when we all begin to see the picture one person at a time. All of us can be proud of the commitment we made to effect the change. Nevertheless, it will not happen until we catch the vision that we are in this together, that change is needed, that quality can be improved, and that it is the right thing to do (Heifetz and Linsky, 2002). However, even the best of intentions at an emergency or disaster will not go well without an effective incident command system (NFA, 2002).

Chief Alan Brunacini of the Phoenix, Arizona Fire Department was very instrumental in helping develop the Incident Command Systems (ICS). Fire Ground Command is the result of Alan's work (Brunacini, 2002). FIRESCOPE helped develop the National Fire Academy model of ICS. This grew out of the wild land fires in California between 1970 and 1985. IMS or the Incident Management System developed to provide a framework for disaster management (NFA, 1989). There is a common denominator for all of the systems that help manage crisis, emergency, and disasters; the goal of each one is to resolve the situation. However, now the public expects quality customer service for fires, EMS, break-ins, floods, tornadoes, and any other major situation. This is about helping resolve situations by acting. Each person involved expects and demands quality.

According to Marshall Sashkin, Ph.D., and Kenneth Kiser, Ph.D., "For Total Quality Management to succeed, management must believe in and act to achieve quality for customers and clients as a primary organizational aim", (Sashkin & Kiser, 1993). The Downtown Tulsa Target Hazard Manual and the Incident Command System are examples of exceptional total quality management designed to benefit the customer or citizen (Grant, 1994). These efforts help bridge the gap from the traditional way of doing business into the current risk reduction methodology of standardization.

Standardizing the 21st Century Fire Service

The Fire Service can learn how to be better risk managers by applying the concepts of international standards. John Voorhees and Robert A. Woellner wrote "ISO 14000 and Risk Management Systems" for the book International Environmental Risk Management.

They said the goal of ISO 14000 is to provide standards for managers to measure and manage environmental impacts and risks (Voorhees and Woellner, 1998). Their book points out that over 100 countries have organized to develop and utilize voluntary standards to manage environmental impacts and risks. People will unite around the common cause to reduce risk, such as environmental risks, fire risks, disaster risks, and health risks.

The world has been searching for a way to manage the environment for many years. The world is also looking at standardization for almost everything, including fire and EMS response. According to David Fatovich, "Emergency medicine is a field of practice based on the knowledge and skills required for the prevention, diagnosis, and management of the acute and urgent aspects of illness and injury affecting patients of all age groups with a full spectrum of undifferentiated physical and behavioral disorders" (Fatovich, 2002). Recent data indicates that EMS is eighty to ninety percent of a METRO agency's emergency business (Hall, 2002).

This quantity of service request comes with considerable regulation and standards. The fire and EMS business is especially time critical. The courts are seeing more and more cases of failing the "duty to act", and "breaching the standard of care petitions" (Scheid, 1997). Therefore, the fire and EMS business is becoming more and more litigious as standards increase, service requests increase, and resources become strained (Brown, 2002).

According to Voorhees and Woellner (1998) deciding to adopt, or implement a standard

is no easy task. The fire officer of the 21st century must have a working knowledge of the relevant standards. After all, the standards making process involves many people. The ISO and NFPA follow three basic principles to develop the "standards of care". The principles are consensus, full participation, and voluntary adoption.

Developing Consensus Standards

Voorhees and Woellner (1998) indicate that to gain consensus, groups prepare a justification, working documents, committee drafts, and a draft international standard. Consensus is first obtained by the technical experts, then by the technical committee and then by the organizations standards experts. Participation is open to all qualified and interested parties. Therefore, the standards have significant weight, because they are industry consensus standards that consider the reasonable thing to do. This points people to the "reasonable man", or value based management theory.

Carl Anderson (1997) writes that value-based management requires the use of five philosophical positions. First is the invisible hand philosophy, which theorizes that no single individual selects the social outcome, yet individuals achieve the outcome via profit seeking. Second is stakeholder analysis, which depends on the Golden Rule, such that managers are limited to only those actions that can be imposed on everyone. Third is the reasonable man argument, which involves finding a middle ground for compromise on dilemmas. Fourth is by shaping competitor behavior so that it will only take a position that does not take advantage of actions that benefit the larger system. Fifth is enlightened self-interest, which sees dilemmas in terms of resolving competing goals in order to

realize freedom to operate in the marketplace (Anderson, 1997). This establishes common ground, or reasonableness between the users, developers, and customers or citizens. The goals of ISO 14000 and NFPA 1710 have common ground.

ISO 14000 was designed to provide standards for managers to measure and manage environmental impacts (Voorhees and Woellner, 1998). Similarly, NFPA 1710 was designed to assist the fire service manager reduce and manage fire service risks, and their subsequent impact on people and the environment (IAFC, 2001). These standards are voluntary guidelines to help organizations protect the environment and manage risk. The standards share commonalties with the ISO 9000 Total Quality Management series of standards.

Consensus Standards Outputs

There are two important theories applied within the standards; excellence through consistency, and flexible effective procedures to achieve management system goals (Hickman, 1993). Therefore, the overall goal of standards is similar to the overall goal of 911 systems. The promulgation of NFPA 1710 for Fire and EMS response allows for the standardized prompt and efficient response of METRO agencies. According to Jeffrey Hickman the overall goal of 911 systems is "to provide prompt and efficient medical attention to persons in need" (Hickman, 1993). Additionally, Hickman says, "rational standards of care, enforced by rigorous judicial and legislative scrutiny, and well constructed guidelines for decision making and operation of the systems, will combine with the diligence that exposure to liability creates, to ensure that 911 systems operate the

way they are intended -- to save lives" (Hickman, 1993). In other words, standardization provides a baseline for discernable measurement or evaluation of organizational performance transforming the 21st century fire service into a standardized profession.

The NFA is providing new tools for the 21st century fire officer to deal with these situations. The new Chief Officer Training Course developed in 2002 by the NFA seeks to provide a proactive view to risk reduction in the fire service (NFA, 2002). The NFA expects to develop a new attitude in the nation's fire officers. The course expands the concepts of engineering, education, and enforcement to include, emergency response, and evaluation. One of the biggest areas of change is in the evaluation phase. Here the focus has turned to risk reduction at the neighborhood level. This is significant because it involves the complete department in gaining "community equity" according to the developers (Brown, Brooks, & Kirtley 2002). The theory is that by gaining community equity the fire department members will be able to influence and model good risk reduction behavior for their neighbors, the citizens (Brown, Brooks, and Kirtley, 2002).

According to the Federal Emergency Management Agency, all fire departments are part of the bigger picture of disaster management (FEMA, 2002). Reducing risk at the neighborhood level allows departments to focus on an "all hazards" approach in their communities (Brown, Kirkley, & Brooks, 2002). It does not matter whether a person is having a fire, a heart attack, or dealing with a tornado. They are still looking for someone to come help relieve their pain and suffering. When the "crisis" is big or complex local fire departments must help manage and mitigate the situation. Therefore, all departments

are involved in overall risk reduction and by definition (and function) are disaster management agencies (McCool, 2000). The expected population of 12 billion people in the 21st century (US Census, 2002) will certainly challenge the fire service to perform at increasingly higher levels of expectation. Performing at high levels of expectation yields considerable dividends for communities and the fire service.

Proper response, staffing, and deployment processes will reduce loss of life, reduce civilian and firefighter injuries, increase survivability of cardiac arrests, reduce property loss, reduce environmental damage, and reduce actuarial loss to insurance companies. These benefits will convert to lower insurance costs and thereby provide more disposable income for the consumer. More disposable income for the consumer will stimulate purchasing or savings. Stimulating purchasing will increase tax collection, and thereby increase community general funds for services. Stimulating savings will increase the money supply, and thereby increase borrowing. Increased borrowing leads to purchasing which leads to increased tax collections for the general fund (Wiedenbaum, 1995). All of these situations will help improve the funding and support for the modern cutting-edge fire department (Brown, 2002).

Conclusion

This study examines NFPA 1710 response times, staffing, and deployment. NFPA 1710 is the most aggressive standard and risk reduction methodology available for the professional fire service today. NFPA 1710 is a risk reduction standard born out of serious debate concerning scholarly research in the area of risk reduction and the fire

service. This literature review provided perspectives that are helpful in understanding the paradigms associated with risk reduction methodologies in the fire service.

Chapter 3-Methodology

Overview

This chapter provides an overview of the methodology used to determine the need for the Tulsa Fire Department to develop risk reduction methodologies in order for them to comply with the response times, staffing, and rapid intervention crew requirements (Critical Criteria Areas, CCA) of NFPA1710. The CCA are depicted in Table 1.

Table 1-Critical Criteria Areas

Time Objectives
4.1.2.1.1 The fire department shall establish the following time objectives:
(1) One minute (60 seconds) for turnout time
(2) *Four minutes (240 seconds) or less for the arrival of the first arriving engine company at a fire suppression incident and/or 8 minutes (480 seconds) or less for the deployment of a full first alarm assignment at a fire suppression incident
(3) Four minutes (240 seconds) or less for the arrival of a unit with first responder or higher level capability at an emergency medical incident
(4) Eight minutes (480 seconds) or less for the arrival of an advanced life support unit at an emergency medical incident, where this service is provided by the fire department
4.1.2.1.2 The fire department shall establish a performance objective of not less than 90 percent for the achievement of each response time objective specified in 4.1.2.1.1.
Staffing Objectives
5.2.2.1.1 These companies shall be staffed with a minimum of four on-duty personnel.
Deployment Objective
5.2.3.1.2* Personnel assigned to the initial arriving company shall have the capability to implement an initial rapid intervention crew (IRIC).

The Critical Criteria Areas, depicted in Table 1 are examined independently, and collectively to determine their individual impact on the overall compliance of the agency. Once the Critical Criteria Areas were determined it was necessary to develop the appropriate research hypotheses.

Research Hypotheses

There were fourteen hypotheses for the project, one main hypothesis, and thirteen sub-hypotheses. Each hypothesis had a research hypothesis and a null hypothesis. The overall or main research hypothesis (Ha) for the project was TFD does not comply with NFPA 1710 in the Critical Criteria Areas. The overall or main null hypothesis (Ho) for the project was TFD does comply with NFPA 1710 in the Critical Criteria Areas.

Research Methodology

The research hypotheses were tested with the aid of the DCB/1710/GAP analysis instrument depicted in Table 2 which is presented at the end of this chapter.

Type of Study

This needs analysis study was a long-run probability study posterior probability) because it took place after the fact. The study was based on one year of data. The study utilized the DCB/1710/GAP for this project based on an examination of the Critical Criteria Areas of NFPA 1710. The nominal concept being studied was the compliance of the agency with 1710. To determine compliance the nominal concept was operationalized as Agency Compliance (AC) and plotted on the Compliance Score Scale (CSS). The

Agency Compliance denotes an agency's compliance with the specific requirements of the selected portions of Chapter 4 and Chapter 5 dealing with response times, staffing objectives, and deployment objectives of 1710 (Critical Criteria Areas) and is denoted by a compliance score (Compliance Score).

Variables

The study examined fourteen objectives using fourteen dependent variables (DV1-14), labeled Standard (S). Likewise, the study used fourteen independent variables (IV1-14), labeled Criteria Type (CT). A Compliant Agency (CA) would be indicated by a Compliance Score of 100 on the Objective being investigated. Additionally, DV14 and IV14 are statistically tested for an Agency Compliance Score (ACS) on the Critical Criteria Areas. Therefore, an Agency Compliance Score of 100 would indicate that the agency complies completely with the Critical Criteria Areas of NFPA 1710. Conversely, an Agency Compliance Score less than 100 indicates a "GAP" in the department's compliance with the standard, and therefore provides an opportunity for improvement options. The "GAPS", or improvement opportunities, are portions of the standard (Objectives) where the department does not meet the Critical Criteria Areas of NFPA 1710. The results of the data analyses and statistical tests are provided in Chapter 4. The summaries of the findings of the study are presented in Chapter 5. An explanation of the data source, type, collection, components, and analyses is appropriate for an understanding of the statistical methodology.

Data Source for the Project

The data used for this research were obtained from the existing TFD information management system. The data were aggregate raw interval data. Additionally, there were no human subjects used for the project. The sample data contained 300, 000 emergency response records, and 263,500 personnel staffing records. Deployment of RIC data were obtained from a combination of the response and staffing records.

Response Records

The response records include information on the incident number, date, time, address, caller phone number, type of call, type of situation found, resources dispatched, time of dispatch, enroute time, on scene time, in service time, and many other fields of information. This study used a cumulative frequency distribution on the response data to prepare the critical fields for statistical analyses for the response criteria. Additionally, all response times (with the exception of EMS) are calculated with an additional 60 seconds (per NFPA 1221) for the Public Safety Communications (911) Center to answer and dispatch the call. The EMS calls have an additional two minutes and thirty seconds added to them because of the average dispatch time required for the third-party medical dispatch system to route the call to the fire department dispatcher.

Staffing Records

The staffing records include the member name, address, phone number, rank, assignment,

and attendance information along with many other important data fields for human resource management functions. These records were used to determine the amount of staffing on a daily basis. Additionally, the Chief of Field Operations Log Book was used to determine staffing anomalies such as three-person companies, units out of service, mutual aid responses, and other significant events of the day. The analyses of these data sets provide the study with the number of personnel on duty each day per unit of resource to determine the staffing levels.

Deployment Records

The combination of response records and staffing records provides the researcher with the information necessary to deduce the ability of the initial arriving unit to deploy a rapid intervention crew for fire fighter rescue and safety. There must be at least four persons on the company in order to adhere to the two-in and two-out criteria of the standard.

Procedure

The procedure started by identifying significant issues from 1710. The author, TFD members, and colleagues reviewed TFD performance in relation to the requirements of 1710. Areas where the investigation group believed TFD meets or exceeds 1710 were not included for evaluation in this project. Three main areas (Critical Criteria Areas) were agreed upon for further investigation. The three areas as discussed earlier were response times, staffing, and deployment (Rapid Intervention Crew). The identification of the Critical Criteria Areas provided the necessary information for the operational

definition of Agency Compliance. The next steps were to collect the appropriate data from the TFD information management system, select the appropriate methodology to investigate the hypotheses, and perform the statistical analyses using the appropriate instrumentation.

Instrumentation

Once the data were collected it was evaluated, formatted, and entered into the DCB/1710/GAP illustrated in Table 2 comprising four sections and eleven columns. Section 1 examines the response time critical criteria. Section 2 reviews the staffing critical criteria. Section 3 depicts the deployment critical criteria. Section 4 provides a summary of the Critical Criteria Areas. Column 1 contains the number of the objective (O) in the critical area that is being evaluated, such as response times. Column 2 contains the Criteria Type (C), such as EMS. Column 3 contains the standard requirement (S), such as four minutes. Column 4 indicates the number of total observations for the critical criteria (OB), such as 17,405. Column 5 indicates the number of times the observations in column 4 met the standard (M) identified in column 3. Column 6 contains the percentage of observations (P) meeting the standard. Column 7 indicates the percentage requirements of the standard (R) for the objective being investigated. Column 8 represents the Compliance Score (CS), which is obtained by dividing the percentage of observations meeting the standard by the percentage requirements for the standard for the objective being investigated converted to a whole number with two significant digits (decimal points). Column 9 contains the calculated z scores (Cz), such as –189.71. Column 10 contains the Table z score (Tz), or critical z, such as –2.33. The last column,

number 11 denotes whether we accept or reject H_o. As previously discussed any Compliance Score under 100 indicates a GAP in the agency's compliance with the critical areas of the standard.

Data Analysis

The aggregate raw interval data collected from the information management system and recorded in the DCB/1710/GAP were subjected to a one-tailed difference of proportions test at the .01 level of significance using a z score. The mean, median, mode, and standard deviations were calculated for each objective. A difference of proportions test was used for all fourteen of the projects 1710 objectives. The null hypotheses (H_o) stated TFD meets the requirements of 1710 in the Critical Criteria Areas. The research hypotheses (H_a) stated TFD does not meet the requirements of 1710 in the Critical Criteria Areas.

Limitations

The data used were internal agency data with multiple entry points and multiple entry persons. Additionally, there is no quality control point or process to review the data for accuracy on a periodic basis. Therefore, some of the collected data within the agency are not suitable for analyses because of the lack of data entry in required fields, obvious input errors that nave not been resolved, or lack of reporting in general. Additionally, exception reports (internal post-facto data changes) are not always reviewed for accuracy, or timeliness. Furthermore, the information management system used to collect the data generates summary reports that do not parallel individual reports. That is, when the

individual reports are summed independently, a summation of the individual reports does not equal the overall summary reports in all cases. For instance, an individual report of EMS calls does not equal the total number of EMS calls in a department summary report of all calls. Therefore, agency summary reports could not be used for the project. This discovery exacerbated the care and focus required for the collection, review, and evaluation of the agency data. Some data could not be reconciled, and therefore were not usable for the study. This exclusion of data was minimal and allowed the study to focus on the accurate and complete data.

This project was conducted for TFD and used internal aggregate raw interval data. It did not address smaller departments, volunteer departments, combination departments, or any other department. The model specifically addresses the implementation of NFPA 1710 for the TFD, a METRO Fire Department.

Table 2-DCB/1710/GAP Instrument

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
S1	**Response Time Critical Criteria**										
	O	C	S	OB	M	P	R	CS	Cz	Tz	D
	1	EMS-1st In	6	17405	8156	0.47	0.90	52.07	-189.71	-2.33	R
	2	Fire-1st In	6	17855	11076	0.62	0.90	68.93	-124.57	-2.33	R
	3	4E, 1L-H	10	740	505	0.68	0.90	75.83	-19.73	-2.33	R
	5	4E, 1L-A	10	614	475	0.77	0.90	85.96	-10.44	-2.33	R
	7	4E, 1L-B	10	268	203	0.76	0.90	84.16	-7.78	-2.33	R
	4	5E, 2L-H	10	102	37	0.36	0.90	40.31	-18.09	-2.33	R
	6	5E, 2L-A	10	122	48	0.39	0.90	43.72	-18.65	-2.33	R
	8	5E, 2L-B	10	151	71	0.47	0.90	52.24	-17.60	-2.33	R
				Section 1 Overall		**0.57**	**0.90**	**62.90**	n/a	n/a	n/a
S2	**Staffing Critical Criteria**										
	O	C	S	OB	M	P	R	CS	Cz	Tz	D
	9	Engines	4	116	89	0.77	1.00	76.72	-2.51	-2.33	R
	10	Trucks	5	65	39	0.60	1.00	60.00	-3.22	-2.33	R
	11	Chiefs	1	5	5	1.00	1.00	100.00	0.00	-2.33	A
	12	Aides	1	5	5	1.00	1.00	100.00	0.00	-2.33	A
				Section 2 Overall		**0.84**	**1.00**	**84.18**	n/a	n/a	n/a
S3	**Deployment Critical Criteria**										
	O	C	S	OB	M	P	R	CS	Cz	Tz	D
	13	IRIC	4	1997	260	0.13	1.00	13.02	-38.87	-2.33	R
				Section 3 Overall		**0.13**	**1.00**	**13.02**	n/a	n/a	n/a
S4	**Critical Criteria Area Summary**										
	O	C	S	OB	M	P	R	CS	Cz	Tz	D
	14	CCA	1710	1300	853	0.66	1.00	65.61	-12.40	-2.33	R
				Section 4 Overall		**0.66**	**1.00**	**65.61**	n/a	n/a	n/a
Table Key											
Symbo		**Explanation**		**Symbol**		**Explanation**					
O		Objective		**M**		Meets					
C		Criteria		**P**		Percentage					
S		Standard		**R**		Required					
OB		Observations		**CS**		Complaince Score					
Cz		Calculated z score		**Tz**		Table (test) z score					
A		Accept Ho		**R**		Reject Ho					
D		Decision									

Chapter 4-Summary of Results

Overview

This section provides a restatement of the hypotheses, the descriptive statistical information, the results of the significance tests, the results of the needs analysis, a description of alternatives, and a conclusion.

Restatement of Hypotheses

There were fourteen hypotheses for the project, one main hypothesis, and thirteen sub-hypotheses. Each hypothesis had a research hypothesis and a null hypothesis. The overall or main research hypothesis (Ha) for the project was TFD does not comply with NFPA 1710 in the Critical Criteria Area. The overall or main null hypothesis (Ho) for the project was TFD does comply with NFPA 1710 in the Critical Criteria Area.

Descriptive Statistical Information

The overall or main research hypothesis states TFD does not meet 1710 in the Critical Criteria Area or, H_a: $\mu_1 \neq \mu_2$. Likewise, the overall or main null hypothesis states TFD does meet 1710 in the Critical Criteria Area or, H_o: $\mu_1 = \mu_2$. The critical value for z for all significance tests was determined as –2.33 at the $P<.01$ level of significance.

As stated earlier over 563,500 records were evaluated including 35,000 incidents. This represents the sample incident response and staffing levels for 2001. The deployment

data were obtained by determining the number of personnel available for staffing each day combined with the number of apparatus in service. Data for significance tests were organized in the following groups, Response Time Objectives 1-8, Staffing Objective 9-12, Deployment Objective 13, and the Overall Objective 14.

Statistical Parameters

The statistical parameters used for the study were the mean, median, mode, and standard deviation. These parameter values were determined for each objective. The parameter values were used to determine the significance of the difference between the observed scores and the expected scores for each of the Objectives of the Critical Criteria Areas of NFPA 1710.

Results of Significance Tests

The results of the significance tests as depicted in Table 2 in chapter 3are as follows using a Critical z Score of –2.33. The study rejects the null hypothesis on all of the hypotheses with the exception of number 11, and number 12. These two hypotheses deal with the staffing levels of the District Chief and his/her aide. The TFD meets these two requirements 100% of the time. However, TFD does not meet the standard on the other 11 sub-hypotheses, or the overall hypothesis, number 14. TFD scored 853 points out of a possible 1300 points on the Compliance Scale for an overall score of 65.61. There are three main areas of opportunity for improvement, EMS 1st in, Five Engine/Two Ladder Responses, and Rapid Intervention Crew Deployment.

Summary of Compliance Score Results

A department meeting the specific requirements of the selected portions of Chapter 4 and Chapter 5 dealing with response times, staffing objectives, and deployment objectives of 1710 would score a 100 on the Compliance Scale (CS) for each objective. Conversely, a department meeting none of the specific requirements of 1710 would score a 0. A Compliance Score of less than 100 for the objective indicates a "Gap" in the department's compliance with the standard.

Results of Needs Analysis

The overall Compliance Score for TFD was calculated as 65.61. The overall Compliant Agency (CA) compliance score was calculated as 100. TFD does not meet the CA requirements as investigated in this study. Therefore, TFD would benefit from developing risk reduction methodologies (or an implementation model) to assist them in obtaining compliance with 1710. Since, TFD is a METRO agency it is assumed that other METRO agencies would benefit from an implementation model.

Description of Alternatives

There are at least three courses of action TFD can take at this point.

Status Quo

TFD could continue to operate as they are currently doing in 2002. However, one should consider the predictability of less than desirable fire loss in lives, property damage, environmental damage, employee injuries, and the survivability of citizens in medical

emergencies. Chief LaCroix and Mayor LaFortune have indicated this will not be the case in Tulsa, Oklahoma.

RBO Process

Tulsa is very proactive in utilizing Results by Objective processes to achieve improvements in the Tulsa Fire Department. This is a collaborative effort between leaders of the TFD, Local 176 IAFF, and other interested stakeholders. TFD has already begun the process to move ahead with an RBO for portions of 1710.

Additional Study

Chief LaCroix has commissioned an officer of the department to study 1710 and the department's compliance of the standard. Furthermore, the officer is expected to make recommendations to the various Staffs, and RBO Committees for development of an implementation model for TFD.

In Conclusion

Tulsa needs to make some changes in their operations. This author favors continuing what Mayor LaFortune, Chief LaCroix, and Local 176 IAFF are doing to allow Tulsa Fire Department to be the leader in compliance with 1710. Tulsa is a leader in many areas of the Fire Service including Hazardous Materials, Technical Rescue, Aircraft Rescue Fire Fighting, Officer Development, National Fire Academy Participation, Domestic Terrorism, Metropolitan Medical Response System, Emergency Operations Community Risk Reduction, and Strategic Planning.

Chapter 5-Discussion and Conclusions

Overview

This final chapter discusses the research results, the hypotheses, the strengths of the study, the weaknesses of the study, opportunities for future research, and the author's conclusions.

Discussion of Research Results

The research indicates the TFD would benefit from developing risk reduction methodologies (or an implementation model) to assist them in obtaining compliance with 1710. Since, TFD is a METRO agency it is assumed that other METRO agencies would benefit from an implementation model. The significance tests of the Hypotheses indicate risk reduction methodologies, or an implementation model is needed.

Discussion of Hypotheses

The hypotheses tested indicated the specific areas where TFD can improve their service deliveries. TFD needs to improve their response times. They arrive at the scene in less than 4 minutes 62 % of the time, *after dispatch*. There is still considerable delay longer than NFPA 1221 allows when TFD responds on Medical Emergencies. This is because the transport agency, Emergency Medical Service Authority (EMSA) has not been able to consistently notify TFD in less than forty-five seconds of the need for 1st Response. TFD Dispatch routinely handles the call in fifteen seconds or less. However, TFD can not

handle the calls they do not receive, and they are seriously challenged to provide the necessary 1st Response care if they are delayed in receiving the call. These two situations are seriously exacerbating negative patient outcome. TFD is reviewing the situation with 911 Director Dale Hunter, Medical Control Director Dr. John Sacra, and President of EMSA, Steve Williamson.

TFD also needs to improve their staffing per unit, or reduce their number of units. The absentee factor because of benefits such as city shifts, vacation, and other authorized leaves provides TFD with personnel being at work 66% of the time. This means over 30 percent of the personnel assigned to shift work are gone on a daily basis. This requires the staffing of three persons per unit over 80% of the time. Units are "punched out of service" when TFD does not have enough personnel to maintain a minimum of three personnel per unit. Therefore, the 42 suppression units funded by the citizens are not always available for service. In other words, the lights are on but no one is home. This leaves the first in engine or ladder area without the appropriate risk reduction.

The only companies with more than three persons are HazMat and ARFF. These companies were not included in the study because they already have constant manning requirements, and they are not primary fire suppression units. TFD does call back personnel to maintain ALS Company staffing at three. They do not call back to maintain two EMTs (Emergency Medical Technicians) and two EMT-Ps (Emergency Medical Technician Paramedics) per ALS (Advanced Life Support) engine as indicated in 1710. TFD does not have a policy for an EMT on every unit. Additionally, ALS engines are allowed to go out of service, or be reduced to BLS (Basic Life Support). Furthermore,

the ALS engines are only dispatched to medical emergencies in their first in engine district. They are not dispatched as ALS units for other first in units. This is under review.

Training also causes TFD to operate with less than 42 units in service. A standard rule of thumb for TFD is one unit out of service per district (5 districts) for training. However, this is not always the case. There have been times that TFD has placed as many as fourteen units out of service for training according to the Assistant Chief records. This too causes the risk reduction methodology developed by TFD to be inappropriate because of the expanded risk management areas and extended response times. A recent study indicated that TFD falls behind in normal mandated training 33% per year, and one year behind every three years. TFD needs to improve their staffing. TFD also needs to improve their deployment methodology.

The current number of companies in service for TFD is 42. This should be reconsidered. TFD can support between thirty and thirty-five companies with fulltime staffing. TFD should consider reallocating their resources within the same budget, and with the retention of the same number of members. Two options are provided for TFD by this author (Brown, 2002). This would improve their risk reduction by over 40 %. Furthermore, TFD would be able to keep the required number of units in service on a more consistent basis. They would also be able to increase the amount of time personnel are available for training. An additional benefit would be the immediate ability to set up a Rapid Intervention Crew of two persons for fire attack. Furthermore, an increase in the number of personnel actually on the units will reduce the number of units required at the

scene of an emergency. This will significantly reduce the total incident response time. Reducing the total incident response time will reduce loss of life, reduce injury, reduce loss of property, and shorten incident time.

Discussion of Strengths of the Study

The strengths of the study include the following. The data used was very reliable due to numerous audits by the Information Management Systems Director and IMS Staff. Chief LaCroix provided every necessary item for the author to conduct the study. Therefore, the members of TFD were involved and very helpful. Also, organizations such as IAFC, IAFF, ICMA, and METRO were very helpful in conducting the study.

Discussion of Weaknesses of the Study

One inherent weakness is that the author is an officer with the TFD. The author used several different editors and confidants to help remove bias and prejudice in the study. However, because the author is a twenty-two year veteran of TFD this would be nearly impossible. Nevertheless, the study has been reviewed numerous times in the effort to minimize the author's bias. Fellow fire and emergency management professionals have validated the DCB/1710/GAP. TFD is the first agency to use it. Time will tell if it meets the need of the TFD and METRO agencies.

Discussion of Opportunities for Future Research

Fire Chiefs of the 21st Century Fire Service have many challenges before them in the area of standard compliance. It seems that each year more and more laws, regulations, and

standards are passed that must be implemented within the METRO agencies. Therefore, IAFC, IAFF, and ICMA along with the NFA and Universities should continue to collaborate to find the best ways to improve the safety and health of our citizens, and our emergency responders.

Conclusion

This project has been a very rewarding time for the author. It has allowed him to make a significant contribution to TFD, the Fire Service, and the body of knowledge. There are a plethora of studies that speak to staffing, response times, and deployment. However, 1710 is relatively new. It places a line in the sand for all METRO agencies to compare their service deliveries to the profession's expectations. This is a great opportunity to turn from litigation over pain and suffering while moving toward implementation. NFPA 1710 is the right thing to do. But, it is not the only right thing to do. Mayor LaFortune, Chief LaCroix, Local 176 IAFF, TFD members, and other METRO agencies are doing many right things. The citizens and members of our organizations need to continue to encourage us all to do things right too!

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Appendix

Table 3-1710 Objectives

Time Objectives

4.1.2.1.1 The fire department shall establish the following time objectives: (1) One minute (60 seconds) for turnout time (2) *Four minutes (240 seconds) or less for the arrival of the first arriving engine company at a fire suppression incident and/or 8 minutes (480 seconds) or less for the deployment of a full first alarm assignment at a fire suppression incident (3) Four minutes (240 seconds) or less for the arrival of a unit with first responder or higher level capability at an emergency medical incident (4) Eight minutes (480 seconds) or less for the arrival of an advanced life support unit at an emergency medical incident, where this service is provided by the fire department The fire department shall establish a performance objective of not less than 90 percent for the achievement of each response time objective specified in 4.1.2.1.1. (This study examined all of the above criteria. However, statistical analysis was only performed on the 4-minute response for EMS and FIRE due to the lack of complete data from the agency.)
Staffing Objectives 5.2.2.1.1 These companies (engines, trucks, ladders, quints) shall be staffed with a minimum of four on-duty personnel (higher risks require 5 or 6 personnel).
Deployment Objective 5.2.3.1.2* Personnel assigned to the initial arriving company shall have the capability to implement an initial rapid intervention crew (IRIC). (4 personnel)

Table 4-1710 Company Staffing Criteria

5.2.2.1 Fire companies whose primary functions are to pump and deliver water and perform basic fire fighting at fires, including search and rescue, shall be known as engine companies.

5.2.2.1.1 These companies shall be staffed with a minimum of four on-duty personnel.

5.2.2.1.2 In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty members.

5.2.2.2 Fire companies whose primary functions are to perform the variety of services associated with truck work, such as forcible entry, ventilation, search and rescue, aerial operations for water delivery and rescue, utility control, illumination, overhaul, and salvage work, shall be known as ladder or truck companies.

5.2.2.2.1 These companies shall be staffed with a minimum of four on-duty personnel.

5.2.2.2.2 In jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions, or other pertinent factors as identified by the authority having jurisdiction, these companies shall be staffed with a minimum of five or six on-duty personnel.

5.2.2.4 Fire companies that deploy with quint apparatus, designed to operate as either an engine company or a ladder company, shall be staffed as specified in 5.2.2. If the company is expected to perform multiple roles simultaneously, additional staffing, above the levels specified in 5.2.2, shall be provided to ensure that those operations can be performed safely, effectively, and efficiently.

5.2.3.1.1 The fire department's fire suppression resources shall be deployed to provide for the arrival of an engine company within a 4-minute response time and/or the initial full alarm assignment within an 8-minute response time to 90 percent of the incidents as established in Chapter 4.

5.2.3.1.2* Personnel assigned to the initial arriving company shall have the capability to implement an initial rapid intervention crew (IRIC).

5.2.3.2.1* The fire department shall have the capability to deploy an initial full alarm assignment within an 8-minute response time to 90 percent of the incidents as established in Chapter 4.

Table 5-1710 Initial Full Alarm Assignment Criteria

5.2.3.2.2 The initial full alarm assignment shall provide for the following:

(1) Establishment of incident command outside of the hazard area for the overall coordination and direction of the initial full alarm assignment. A minimum of one individual shall be dedicated to this task.

(2) Establishment of an uninterrupted water supply of a minimum 1480 L/min (400 gpm) for 30 minutes. Supply line(s) shall be maintained by an operator who shall ensure uninterrupted water flow application.

(3) Establishment of an effective water flow application rate of 1110 L/min (300 gpm) from two handlines, each of which shall have a minimum of 370 L/min (100 gpm). Attack and backup lines shall be operated by a minimum of two personnel each to effectively and safely maintain the line.

(4) Provision of one support person for each attack and backup line deployed to provide hydrant hookup and to assist in line lays, utility control, and forcible entry.

(5) A minimum of one victim search and rescue team shall be part of the initial full alarm assignment. Each search and rescue team shall consist of a minimum of two personnel.

(6) A minimum of one ventilation team shall be part of the initial full alarm assignment. Each ventilation team shall consist of a minimum of two personnel.

(7) If an aerial device is used in operations, one person shall function as an aerial operator who shall maintain primary control of the aerial device at all times.

(8) Establishment of an IRIC that shall consist of a minimum of two properly equipped and trained personnel.

Table 6-1710 Emergency Medical Service Criteria

5.3* Emergency Medical Services.

5.3.3.4 Service Delivery Deployment.

5.3.3.4.2 The fire department's EMS for providing first responder with AED shall be deployed to provide for the arrival of a first responder with AED company within a 4-minute response time to 90 percent of the incidents as established in Chapter 4.

5.3.3.4.3* When provided, the fire department's EMS for providing ALS shall be deployed to provide for the arrival of an ALS company within an 8-minute response time to 90 percent of the incidents as established in Chapter 4.

5.3.3.4.4 Personnel deployed to ALS emergency responses shall include a minimum of two members trained at the emergency medical technician - paramedic level and two members trained at the emergency medical technician - basic level arriving on scene within the established response time.

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