USING NATIONAL STANDARDS TO CREATE

A STAFFING AND DEPLOYMENT PLAN

EXECUTIVE LEADERSHIP

BY: Michael Cardwell

Deerfield Township Fire Rescue
Deerfield Township, Ohio

An Applied research project submitted to the National Fire Academy
As part of the Executive Fire Officer Program
June, 2006

Appendices Not Included. Please visit the Learning Resource Center on the Web at http://www.lrc.dhs.gov/ to learn how to obtain this report in its entirety through Interlibrary Loan.

CERTIFICATION STATEMENT

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

Signed:_____

Abstract

The problem was Deerfield Township Fire Rescue had not conducted an overall staffing and initial response deployment study to determine personnel needs for initial emergency scene operations. The purpose of this project was to develop an overall staffing and initial response deployment plan based on information gathered during a study determining personnel needs for initial emergency scene operations. This was an action research project. The research questions were:

1. What national standards specific to overall staffing and initial response deployment should be considered when conducting a staffing and deployment study?
2. How do departments' overall staffing and initial response deployment compare to those standards?
3. What overall staffing and initial response deployment initiatives are fire departments protecting small and mid-sized communities using?
4. What improvements should Deerfield Township Fire Rescue adopt as part of their effort to meet overall staffing and initial response deployment standards?

The procedures involved conducting background research to identify national standards and benchmarks associated with staffing and deployment. A survey of regional departments of similar make-up was conducted to determine how other departments met staffing and deployment standards. A review of current Deerfield Township staffing and deployment procedures was completed, as was an analysis of how Deerfield Township stood in comparison to identified national standards. Based on this analysis, a list of

actions required to bring Deerfield Township Fire Rescue into compliance with national staffing and deployment standards was generated.

As a result of this project, a draft staffing and deployment plan for Deerfield Township was developed. This plan provided an implementation path for meeting national standards for staffing and deployment.

Table of Contents

Introduction

The problem is Deerfield Township Fire Rescue has not conducted an overall staffing and initial response deployment study to determine personnel needs for initial emergency scene operations. The purpose of this project is to develop an overall staffing and initial response deployment plan based on information gathered during a study determining personnel needs for initial emergency scene operations. This is an action research project. The research questions are:

1. What national standards specific to overall staffing and initial response deployment should be considered when conducting a staffing and deployment study?
2. How do departments' overall staffing and initial response deployment compare to these standards?
3. What overall staffing and initial response deployment initiatives are fire departments protecting small to mid-sized communities using?
4. What improvements should Deerfield Township Fire Rescue adopt as part of their effort to meet overall staffing and initial response deployment standards?

Background and Significance

As the mission of the fire service changes, one theme remains the same - it takes personnel, delivered to an emergency scene in adequate numbers and in a timely manner, to safely manage an incident. In order to ensure an adequate number of personnel, a Fire Chief has to consider the two components of personnel: staffing and deployment. Staffing refers to the overall number of personnel available on-duty or on-call at any given time. Deployment refers to

the number of personnel dispatched or sent to a given incident. The key is to achieve an appropriate balance between the two.

Staffing continues to a primary concern of fire service officials across the country. A recent study conducted by the International Association of Fire Chiefs found that that the majority of Chief's surveyed identified staffing as their primary challenge Funding is cited as the fire chiefs' second top challenge (Fire Chief, 2006). Since personnel costs are usually the largest percentage of a department's budget, any increase in staffing is bound to have an impact on funding. Any reduction in funding is eventually going to impact staffing.

Obtaining or maintaining staffing can be a problem regardless of the size or type of department. Departments protecting rapidly growing districts are pressed by growth that outstrips their ability to keep up. Older communities with shrinking populations and tax bases are being forced to maintain or reduce staffing despite the established trend that indicates as a community ages and income levels drop, requests for service increase. Volunteer departments are finding it difficult to recruit or retain staffing as training and time commitments placed on their personnel continue to expand.

Deployment is closely linked to staffing. Every incident has a number of tasks which must be completed to bring the call to a successful conclusion. The ability to complete these tasks is dependent on having the personnel and equipment to meet the requirements. Chief Billy Goldfeder, in an interview about on-scene staffing, feels certain tasks, such as advancing a hoseline, require a certain number of personnel, regardless of how many people are actually on a deployed piece of apparatus. Each incident is made up of tasks which absolutely need to be done (Keyson, 2002). If the tasks aren't completed, the strategic objectives of that incident aren't likely to be met.

Where inadequate staffing exists, fire chiefs are forced to make critical deployment choices. For many it becomes a choice of limiting in-service companies or operating with less than full crew complements. In either case, deploying an adequate number of personnel for the initial response becomes more difficult.

The link between the deployment of adequate resources to the fireground and firefighter safety has been previously established. In his research analyzing the relationship between staffing levels, and injuries, Michael Vatter (1998) notes, "From the multiple regression model and correlational analysis, the following inferences can be made. It indicates that the number of firefighters responding to a fire has an inverse relationship to the number of injuries that can be expected" (p. 20). His research project included a review of several published studies, all of which concluded that injury rates are going to increase when fewer firefighters are operating on-scene.

Firefighter fatality investigations conducted by the National Institute of Safety and Health (NIOSH) support this conclusion. A review of firefighter fatalities occurring as a result of traumatic event occurring at working fire incidents linked a significant number of these deaths to insufficient on-scene staffing. Between 2000 and 2004, 10 of the 29 (34%) firefighter fatality incidents of this type NIOSH reviewed are linked to an insufficient number of personnel on scene (Cardwell, 2005). The problem of firefighter fatalities related to on-scene resources has been recognized as one of national importance. At the 2004 Life Safety Summit sponsored by the National Fallen Firefighter's Foundation, one of the sixteen initiatives calls for "National Standards for emergency response policies and procedures to be developed and championed" (Routley, 2004).

Located in Southwest Ohio Deerfield Township Fire Rescue (DTFR) is a rapidly growing suburban community. The district encompasses more 19 square miles with a nighttime population of more than 31,000. The department provides Fire, EMS, and Rescue services out of three stations with a quint, two engines, and three ALS transport units. Staffing at each station is four personnel cross-staffing the fire and EMS units. An additional light rescue vehicle is staffed with two firefighters/paramedics/rescue technicians providing support on all EMS, rescue, and fire calls as needed. The overall staffing level is fourteen firefighters per shift.

Ten years ago Deerfield Township's staffed fire protection came from one station with a second station staffed with volunteers and the third station not yet built. As the area has developed, additional stations and staffing have been added to keep up with the growing demand for service. This growth has come in spurts and has not been a result of any advanced staffing or deployment plan. The department, formed as a result of the dissolution of a joint fire district in 1998, has never completed a staffing or deployment study.

As the area continues to develop, the number of emergency calls and requests for service is steadily increasing. All expectations call for a fully developed township with a population approaching 50,000 within the next ten years. Current staffing is adequate for current average daily call volume but inadequate for peak demand periods. These periods, with three and four emergency calls simultaneously, are becoming more common. Additionally the frequency of working structure fires occurring while one or more units are out on previous incidents has increased significantly.

The issue of deployment, getting first due units to EMS and fire calls in a timely manner, also needs to be studied and addressed. DTFR deploys four-person fire companies. However, if the EMS unit is out of quarters for a previous call, then that fire company deploys with two.

Automatic aid from surrounding departments is routinely used, but it comes with a built-in response delay due to travel distance. The ability to deploy units to the scene in a timely manner, but with adequate personnel, must be a part of any future staffing plan.

Deerfield Township requires a plan to guide future growth. It needs to be based on local needs, but attempt to meet national staffing and deployment standards. It needs to address the increasing number of emergency calls, ensuring adequate resources to handle multiple calls. At the same time, it needs to balance overall staffing with a deployment plan which best delivers resources to the emergency scene within the time frame where intervention has a significantly better chance of producing a positive outcome.

This project is related to the United States Fire Administration (USFA) Operational Objective to appropriately respond in a timely manner to emergent issues. This project is related to the Executive Leadership Course goal of conceptualizing and employing key processes used by executive-level managers.

Literature Review

The first question to be addressed is identifying national standards for overall staffing and initial response deployment. While fire service staffing and deployment patterns in the United States vary widely, there have been several initiatives on a national level to create some standards for departments to use as guides or standards of measure. The goal of these measures is to provide firefighters with the personnel resources necessary to perform their jobs safely and efficiently. It's a two part issue: distributing resources to allow for a rapid initial response, and ensuring that an overall effective force is delivered to complete the multiple tasks required to bring the incident under control. *The Fire Protection Handbook*, 19th Edition refers to rapid

initial response deployment as a department's "capability." "Capacity" is defined as a measure of a department's overall staffing ability to deliver an effective number of resources to deal with multiple tasks at a single call, or multiple calls simultaneously (Cote, 2005).

The overall goal is not disputed: get fire service resources to an emergency scene within a time frame where they can affect a successful outcome. Whether referring to a department's capability or capacity, the goal remains the same. Both the fire and emergency medical services agree on this as a critical performance objective.

The first part of the staffing and deployment issue which needs to be considered is requirements for the initial response. For the fire service, the rate of fire development defines a time window where the fire is growing, but is not yet to the point of making interior conditions untenable for sustaining life and attacking the stability of the structure itself. During the growth phase, compartment temperatures remain relatively low while the fire remains localized. However, once flashover occurs, and the fire reaches its fully developed phase, anyone who has not escaped the compartment of the fire is not likely to survive. While the time required for flashover to occur varies widely depending on a variety of factors, the standard time temperature curve has shown that flashover is most likely to occur after six to eight minutes of growth (Wiley, 1999).

For emergency medical providers, the idea of rapid emergency response also has scientific significance. For years the American Heart Association (AHA) has published guidelines which advocated early defibrillation in cases of sudden cardiac arrest. In 2002 more than 330,000 cardiac-related deaths occurred out of hospital. Of all reported field-treated cardiac arrests only 6.4% of the patients survive. However, with early CPR and defibrillation intervention that number can raise as high as 20%. Without it, the survivability rate falls to just

about 2%. According to the research, rapid response by EMS with defibrillation capability within six to eight minutes is crucial. (AHA, 2006).

In the past distance was the benchmark used to measure a department's ability to provide a rapid initial response. The Insurance Services Office (ISO), a creation of the insurance agency, has the responsibility of rating the ability of fire departments to respond to fire incidents throughout their response district. ISO uses the standard of 1.5 miles for the first due engine company, 2.5 miles for a ladder-service company, to measure whether a department can place first-due resources on-scene in a timely manner (ISO, 1993).

In it's *Fire & Emergency Service Self-Assessment Manual* the Commission of Fire Accreditation International (CFAI) traces foundation of the 1.5 mile standard. Based on a vehicle averaging 35 miles per hour it could traverse .5833 miles every minute. Taking into account the need to slow or stop at intersections an emergency vehicle can reasonable expect to reach an emergency scene a distance of 1.5 miles from the station within three to four minutes (CFAI, 1997). While this measurement works in an urban environment, it does not accurately reflect current speed limits and road conditions in suburban or rural environments.

The problem associated with relying solely on a distance standard is that it ignores the other factors associated with rapidly deploying a first due unit. In fact, time is the enemy in any emergency response. Time continues to run from the moment an incident occurs until corrective action is initiated (Zikmund, 2001). A certain percentage of that time – the time from the onset until the incident is reported – is beyond fire service control. This is precisely the reason that emergency services needs to minimize it's call receipt, turnout, and travel time.

In his paper *Developing and Evaluating Response Time Criteria,* Joe Kroboth (2003) identified several national organizations who have established a time standard for the initial

response. A time standard differs from the traditional mileage standard it that it includes allowances for the other two components of response time: call receipt time, and turnout time. Call receipt time is the amount of time from the initiation of a 9-1-1 call until it is dispatched to the appropriate response agency. Turnout time is the amount of time a fire company takes to receive the call and initiate their response.

The latest attempt to create a national deployment standard is the National Fire Protection Association's (NFPA) *Standard 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, 2004 Edition. This standard calls for a travel time of no more than four minutes for the first due company. *NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems* sets a 60 second time allowance for receiving/dispatching the call. NFPA 1710 allows 60 seconds for turnout time, from the receipt of the call until the responding unit(s) are on the road. Factored together, this creates a total response time of 360 seconds (6 minutes) or less to 90% of a department's emergency calls (NFPA, 2005c).

Any deployment standard must address the need to rapidly deliver an initial company with the personnel capable of initiating effective intervention. In his book Fireground Strategies, Anthony Avillo (2002) notes,

> Many of today's fire departments respond with less than adequate manpower levels. As a result, firefighters on the initial response often overextend themselves to accomplish the many tasks required at a working structure fire, especially in the initial stages of operation. These tasks require a Herculean effort on the part of the undermanned fire force (p. 36).

The Occupational Safety and Health Administration's (OSHA) Respiratory Protection Standard requires that firefighters operate with two personnel together at any hazardous environment. At the same time, two equally trained and equipped firefighters must be available on-scene in case an emergency arises. Ohio is not an OSHA state but has adopted similar language (OBWC, 1995). Referred to as the two-in, two-out requirement, this code has become the basis for establishing a four-person fire company as the national standard. It's adoption has forced any departments to alter their procedures and push for additional staffing (Baltic, 1998).

NFPA standards use a four-person company as a safety requirement in several standards, including *NFPA 1410: Standard on Training for Initial Emergency Scene Operations,* 2000 Ed., and *NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs,* 2002 Ed. Both NPFA 1410 and 1500 call for a four person initial response. It is important to note that there is no requirement that all four personnel arrive on the same apparatus, only that they arrive at the same time (NFPA 2005a).

Defining a department's capacity to provide an adequate number of personnel to an emergency scene must also be reviewed in the development of a staffing and deployment standard. Determining the number of apparatus and personnel required at an incident is truly a question of resource allocation. If too many resources are allocated to one incident, the remainder of the response district may be left without adequate coverage. This potentially results in significant time delays for the response to any subsequent calls. If too few resources are allocated, the size and scope of the incident may get beyond what on-scene crews can handle. As a result, firefighters may be placed in positions of unnecessary risk, and additional loss is likely to occur (Carter & Rausch, 1999).

A traditional multi-company response would include three fire companies (two engines and truck), an EMS unit, and a command officer. Assuming traditional urban staffing of four personnel per fire company this translates to 15 personnel assigned to a first alarm fire response. The current ISO assessment allows for a maximum of 15 points – one per person – for a structural response (ISO, 1980). For years, many departments have used this as a baseline first alarm assignment, regardless of the type of structure.

The ISO Public Protection Classification Survey provides a formula for determining the amount of credit a department receives for providing adequate personnel to an fire incident. It factors the actual number of personnel on duty daily against the number of companies required to handle a working fire incident. Full credit is 15 points (ISO, 1980). The ISO grading schedule specifically disallows counting automatic aid companies for manpower purposes (remember, ISO is grading a department's overall capabilities, not how it responds to specific incidents). It is a good tool for evaluating a department's capacity to provide standard of cover.

Risk assessment is viewed today as an important step in determining a fire department's response to reported structure fires. Risk assessment is a process of measuring the probability of an event occurring against the potential damage that may result if an event were to occur. CFAI advocates completing a hazard risk assessment as part of any staffing and deployment study:

> Once the hazard assessment is completed, it is possible to make better decisions with respect to improve resource deployment plans and determine staffing levels. It is also possible that risk assessment may point to code amendments that are needed to mitigate a particular problem. As you review the flow chart for the standards of response coverage

model, you will note that risk assessment is not only the first step of this process, but that it must be re-visited from time to time to determine if the deployment plan is consistent with the growth and development of the community (CFAI, 1997).

The next step in determining a department's capacity to respond to specific types of emergency calls requires using the process of task analysis. Task analysis involves reviewing an incident type to determine the tasks which normally must be completed in order to bring the incident to a safe and efficient conclusion. The process includes determining the order which these tasks normally occur, whether they are sequential or simultaneous, and the number of personnel normally required to complete them. The process also involves determining what constitutes a reasonable safety reserve force in case a problem arises.

In his textbook *Fire Command, 2nd Edition* (2002) Chief Alan Brunacini advocates this approach. Normally, the process of matching resources to potential conditions is based on previously gathered information. Certain incident types will have a specific number of tasks which will require the dispatching of a certain number of resources. This "deployment math" can be a dynamic process and may have to be adjusted by the incident commander upon their arrival. Having predetermined the necessary resources to meet the conditions reported to the dispatcher is important in correctly deploying initial resources.

NFPA 1710 establishes an initial response standard that requires a department determine staffing and initial response capabilities based on both hazard assessment and task analysis. Section 5.2.1 directs a department to use task analysis while considering life hazard, potential property loss, internal protection, and likely types of tactics and evolutions when developing a staffing and deployment plan. NFPA 1710 also requires an initial alarm assignment provide enough personnel to meet specific tasks which normally are required for safe and effective

fireground operations. As a further step, departments are also required to specify extra-alarm capabilities for larger incidents (NFPA, 2005c).

Task analysis does not need to be a complicated process. It involves reviewing all initial tasks which need to be completed simultaneously during initial fireground operations. One important point to remember is matching task analysis to personnel is not the complete answer. All tasks being performed in a hazardous environment must be perform at least in teams of two. For accountability purposes, companies or teams should not be split, which requires the assignment of task teams. Additionally, if all personnel on the initial response are assigned, that leaves no personnel available in staging. A good task analysis considers all these factors and provides sufficient resources appropriately grouped to meet the demands (Harkes, 2005).

One significant change in the fire service that has directly impacted a department's response capability is the introduction the Rapid Intervention Crew (RIT). RIT is now a standard part of many departments' response. NFPA 1710 calls for a minimum of two personnel assigned on the initial response to this task. However several recent studies, most notably studies completed in Seattle and Phoenix, indicate that the actual number of personnel required to affect a rescue is significantly higher. "The research found that the fire service has grossly underestimated both the number of rescuers and the time required for rapid intervention teams to enter the building and find and move each firefighter to safety" (Morris, 2005). In many cases a full additional four-person company is now required as part of the initial response.

In determining how many companies and personnel are required, and where to place those resources, the fire service is turning away from traditional formulas in favor of improved statistical analysis and mapping technology. In the past additional companies were added as a population expanded and the number of calls increased. According to Chief Ronny Coleman, the

old benchmark, developed by the International City/County Management Association (ICMA), called for one firefighter for every 1000 residents. Another formula called for one fire station for every seven square miles of territory, which is based on the ISO formula using a 1.5 mile response standard (Coleman, 2005).

In determining how a department establishes a standard of cover for fire station deployment, the CFAI recommends adopting what they refer to as a fractile response. Simply stated, this is a standard of response which calls for a department to meet the largest areas of need within the minimum response times, but recognizes that a small percentage of emergency requests will lie outside that standard. For example, a department can choose rather than build stations to provide even geographic coverage, it could choose to co-locate companies in one location and leave two less populated and lower risk areas with a single station single company (CFAI, 1997).

Another recent development is the use of collected response data and Global Information System (GIS) mapping. Through the use of data collected as part of previous emergency response calls, an integrated GIS mapping program is able to plot out areas which require additional resources. Resources can be added or reallocated to better meet the needs of a department's staffing and deployment plan. Overall staffing can be anticipated and additional resources procured before existing units and personnel are overtaxed (Johnson, 2004).

Based on available literature, there does not appear to be any systematic or standardized approach to determining overall staffing needs. The variety of systems which provide fire protection and EMS delivery in the United States makes developing a system of this type difficult. However, most departments do seem to lean on national standards for staffing and deployment to help justify overall staffing. Creating a minimum staffing standard for each

apparatus and a standard of cover which requires a minimum initial response capability are useful in plotting an overall staffing number. The tools outlined above can be used to help a department best locate where those resources can best be placed to meet national time or distance response standards.

The second question to be addressed involves comparing departments' overall staffing and initial response deployment to existing national standards. Unfortunately the answer appears to be not very well. An article appearing in the January Boston Globe found that only 35% of fire departments across the country are able to meet response standards outlined by NFPA 1710 and 1720. For career departments, the number of departments meeting the four minute initial unit on-scene and eight minute full alarm standard has declined significantly from 75% back in 1986 to 58% today. Using the FRMS incident reporting database, the Globe estimates more than a billion in fire losses annually could have been prevented if departments were able to meet the six minute response standard (Fire Chief, 2006).

In 2002, the U.S. Fire Administration (USFA) released *A Needs Assessment of the U.S. Fire Service*, a survey analysis of fire departments and their service delivery. The document is the first significant, comprehensive survey of fire departments across the United States. A large portion of the survey focused on personnel and response capabilities. Since the report was published prior to the release of the NFPA 1710 standard in 2004, there is no attempt to correlate the survey to national staffing or deployment standards. However, it is possible to extrapolate some conclusions based on the data reported.

Based on the data reported, smaller career departments protecting communities with a population of less than 100,000 appear to be less positioned to meet overall staffing and initial response standards that larger urban departments. They report having fewer personnel, apparatus

and stations per capita than larger cities. While not reported, it is possible to assume that a larger percentage of departments in these categories are in transition, either facing increasing demands from growing populations or decreasing revenues as populations shrink. This undoubtedly presents additional challenges to these departments (USFA, 2002).

One trend which was clearly identified in the 2002 Needs Assessment study is the high percentage of departments operating fire companies with less than four personnel. Departments in transition, growing or shrinking, are faced with the problem of stretching to meet demands that outstrip resources. Fire Administrations are often forced to choose between running apparatus short-staffed or reducing the number of companies (Hoffmann, 2003b). Given the political fallout that often accompanies closing a fire company or the cry for service in newly developed area before funding is in place to provide it, chiefs are often forced to run short-staffed apparatus.

For many departments, the answer to short-staffed apparatus is to send multiple apparatus. NFPA 1710 does not specify that four personnel have to arrive on the same apparatus, only that they arrive prior to the six-minute time limit. That works for the smaller calls which have few tasks required. However, if the total number of apparatus dispatched to a reported structure fire remains the same, even when responding with understaffed companies, the margin for error or the unexpected is cut significantly. Resources need to be based on personnel, not just apparatus (Bingham, 2004).

The introduction of RIT into the fire service is one area where departments appear to be making strides towards meeting and exceeding the standard. This is especially true for departments responding with understaffed companies or less than adequate initial responses. NFPA 1710 requires two personnel assigned to the initial RIT assignment. Many departments

are meeting this requirement by adding an additional company to reported structure fire assignments. Command officers, however, must avoid the temptation to use RIT personnel as their tactical reserve or reassign the RIT to primary suppression tasks. If an emergency does arrive, and command has to assemble a rescue team from other fireground activities, the situation can get significantly worse (Hoffmann, 2003a).

Reaction to national response standards and minimum staffing standards (even if indirectly created) has been mixed. A Fire Chief magazine survey concerning implementation of OSHA's respiratory protection regulation requiring two- in, two-out found many chiefs unhappy with its effect. "The major concern is that resources needed to implement a practical two-in/two-out policy without unduly delaying interior operations will simply be unavailable to many fire departments" (Baltic, 1998). The other position notes that the fire service has done a poor job of creating and enforcing standards and procedures. "If we are truly unable to monitor and modify our activities, then maybe we are out-of-control and need the intervention of OSHA to save us from ourselves" (Scott, 2002).

The third question involves identifying staffing and deployment initiatives other departments are using to meet these national standards. While most chief officers would like to simply add staff or companies to meet staffing and deployment standards, the fiscal reality is that most departments cannot. Reasons that local communities do not (or are not asked to) financially support their fire departments vary. Discussion on the topic swing from political (the national fire service has not organized a national campaign to force improved staffing) to local (fire departments have a long tradition, founded in the volunteer fire service, of doing more with less). Reality probably lies in a combination of several reasons.

The 2002 U.S. Fire Administration Needs Assessment of the U.S. Fire Service confirms that overall staffing and initial response deployment is a significant problem. Using data from that study, then NFPA President James Shannon, testifying before Congress in June, 2003 in support of the SAFER Act, made the statement that "at least 65% of our nation's cities and towns don't have enough fire stations to achieve the widely recognized ISO response-time guidelines…in communities between 10,000 and 100,000, just 20 to 26% of departments offer that [4-person engine company] necessary coverage" (Weiger, 2004). That study helped quantify the issue to the extent that Congress acted to provide some financial support.

Known as SAFER, the Staffing for Adequate Fire and Emergency Response provides direct funds to the local communities to add staffing or aid in recruitment. Using a competitive grant process, SAFER is funded to provide $7.6 billion in grants over the next seven years to communities of all sizes. The aim of the program is to help bring community departments into compliance with NFPA 1710 and 1720. Modeled on the Community-Oriented Policing Services program, SAFER is the first federally funded program to provide financial support on such a large scale (Weiger, 2004).

National staffing standards such as NFPA 1710, the adoption of the OSHA Respiratory Protection Standard (2-in/2-out) and an increased national emphasis on Rapid Intervention has forced departments to reconsider how they operate. The traditional concept of two engines and a truck, long the model first alarm assignment, has undergone some significant changes. Initial alarm assignments are no longer built around apparatus, but around the personnel they deliver. Three engines and two trucks in an urban environment may deliver 22 firefighters but in a suburban or rural environment may bring only 12 to 15 personnel.

Where understaffed fire companies are the norm, tactics have been adjusted to compensate for the lack of personnel. An example of this involves first due engine company operations. In the past the first-due engine company may be responsible for both the initial attack and water supply. Now engine apparatus are being designed with 750 or 1000 gallon water tanks and the initial apparatus confines its activities to a quick attack while the second engine makes the hydrant connection. Its an all or nothing proposition that if things go as planned results in a quick knockdown, but has the risk of allowing a structure to burn down because of a delay in establishing water supply or deploying the back-up line (Deluca, 2003).

Some departments have undertaken their own analysis to determine staffing requirements for their own department. The consideration of local factors such as weather conditions, training and fitness levels, local construction techniques, and even leadership skills all play a role in whether a department requires three- or four-person fore companies to accomplish tasks on the fireground (Lawrence, 2001). A series of fire company tests performed by the Dallas Fire Department in 1984 concluded that larger fire companies best suited the needs of that urban department. Dr. Lawrence cites the example of a smaller department, Auburn Alabama, creating a series of tests to evaluate the difference in performance between two-person crews (simulating a three person fire company) and three-person crews (simulating a four-person fire company). The tests resulted in maintain under-staffed fire companies with the addition of a squad company to respond on all fire calls (Lawrence, 2001).

Another initiative more departments are turning to is a more aggressive use of mutual aid and automatic aid for first response deployments. The NFPA staffing standard does not require four-person staffing of all front-line fire apparatus; it requires a four person initial response. In order to continue to provide a rapid first response capability, departments choose to understaff

companies or cross-staff an engine and an EMS unit with the same crew, handling first-emergency first. Since working structure fires or complex rescue calls are becoming more infrequent, this arrangement gets a more rapid response to the routine calls. For the more manpower-intensive calls, automatic or mutual aid is dispatched to fill out the balance of the first alarm response.

Regular use of automatic aid provides several benefits. Most important is it provides a smaller department the ability to complete the tasks required to bring an incident under control more rapidly. Steve Pegram illustrates this point in his article "Number's Crunch." A simple task analysis for a one-bedroom fire shows the need to deploy 19 firefighters on the initial response. For many small to medium sized departments, this would strip or outstrip all available resources. In many cases, a neighboring department is closer than in-district fire units. With automatic aid departments regularly working together, one department can become an extension of another. The fire is controlled while keeping the remainder of the community and firefighters safe (Pegram, 2001).

The fourth question involves determining what improvements Deerfield Township should make as part of its staffing and deployment plan. A staffing and deployment plan, when the numbers and standards are taken away, is at heart a balance between capacity and capability. The goal is to provide an appropriate staffing level to the community which places resources where they are most likely to be needed, yet delivers them in a way which optimizes firefighter efficiency and safety. Achieving maximum service delivery capability involves placing initial rapid response resources in every neighborhood. Achieving maximum fire service efficiency and safety capacity would require placing all the resources together and responding "en mass."

Achieving this balance requires a thorough understanding and application of risk management tools. As the book Emergency Incident Risk Management points out,

> Risk management is about choices – decisions that have to be made, often on a daily basis, but that depend upon the review and analysis of quality information…Many decisions are not easy, and the data that have been converted to information will not always provide a clear-cut choice (Kipp & Loflin, 1996).

Before any risk management decision can be made, clearly defined goals and measurable objectives need to be set and agreed-upon. The goals set the destination for any evaluative process; the objectives are the steps along the way towards reaching that destination. Of the universally recognized risk management goals, limiting interruption of service, predictable outcome from daily operations, and standard compliance are the goals which apply to establishing a staffing and deployment plan (Kipp & Loflin, 1996).

The fire service has adopted a risk management philosophy which impacts the context in which staffing and deployment are viewed. The concept of risk a lot to save a life, risk a little to save property, risk nothing to save nothing has taught firefighters to more closely consider their own safety when operating on emergency scenes. It has also considerably shortened the interior firefighting operations window. Chief Ronny Coleman expresses the position that firefighters come to view interior operations in two, five-minute intervals. If the incident isn't clearly under way to being controlled by the end of the second period, then the question of risk vs. gain needs to be seriously re-examined. His "Diamond Time of Firefighting" focuses attention on the fact that time is truly the enemy (Coleman, 2005).

This shortened window places additional emphasis on the need to have in place the overall staffing or initial response deployment plan to get resources to the scene of a multiple-

resource emergency call as quickly as possible. If staffing is insufficient for handling one working incident or the ability to handle that working incident is crippled by previous routine calls that indicates a staffing shortage which must be addressed. The first-emergency first philosophy is no longer acceptable.

Research has indicated several effective methods which can be used to analyze resource need for the initial response deployment. Hazard assessment by occupancy type, task analysis and task team assignment can be used by a department to determine their deployment needs to specific types of calls. Resource location and placement can be determined through use of existing department assessment tools such as ISO, the CFAI process, or through use of GIS mapping tools based on local data.

Research has also made it clear that although local conditions may vary, staffing for the initial response needs to be sufficient for that first unit to initiate two and sometimes even three tasks simultaneously. Any initial response of less than four personnel doesn't necessarily compromise firefighter safety, but it does limit their focus to a single task. Whether it's an EMS, fire, or rescue call, that limited focus will have an impact on a department's ability to successfully manage incidents.

Performance standards are the key to measuring a department's ability to effectively deploy. Whether measuring response capacity based on mileage or time, both appear to result in the same window of opportunity to make a difference. The key is still to create a measurable standard that a department can measure its performance by. This measurement of performance will help the organization make future decisions regarding staffing. Overall staffing has to be driven by a department's ability or inability to meet response standards for initial response, first

due staffing, and initial response deployment. The measure of a department's capabilities will determine its overall capacity.

Procedures

Background Research

A literature review of materials from the National Fire Academy Learning Resource Center was conducted. Additional materials were gathered from published fire service sources, journals, and on-line. Based on this review a list of standards and comparative information related to staffing or deployment was developed. Each of the referenced documents was researched to determine the benchmarks a department would need to meet in or to meet the applicable part of each standard.

Regional Survey

A survey of regional fire departments was conducted to identify staffing patterns being used locally. The departments included in the survey had similar qualities to Deerfield Township in terms of size, staffing (on-station departments only were surveyed), and deployment (at least two stations). The survey was conducted over the phone and included information gathered from a Chief Officer or Shift Commander. Part I of the survey asked for background information on the department, and results were categorized based on a comparison to Deerfield Township. Part II reviewed how each department staffed their first-due apparatus, their distribution of resources (by station), and their first alarm response to reported structure fire, including the use of automatic aid.

Local Analysis

An analysis of the current Deerfield Township Staffing and Response procedures was completed. The period of study included data gathered over a one-year period of time. The analysis evaluated response times to all types of calls for first due responding units. Data was broken down two ways: by response district and by how Deerfield Township units measured against national response time standards. An analysis of Deerfield Township's structural fire responses was conducted. Each call was measured against response time and staffing standards. Data was gathered from the incident reporting system used to report data to the State of Ohio.

Next, Deerfield Township's staffing and deployment were compared with previously identified standards. Each listed standard or benchmark was checked to see if it was being currently met in Deerfield Township. Specific measures included the following: company level staffing, initial response deployment, initial response based on mileage and response time, and full alarm response based on mileage and response time. In each case, the standard was measured against a minimum 90% achievement rate.

Finally, an analysis was conducted to determine what it would take in terms of staffing, distribution, and deployment to meet each of the identified standards. In each case, a 90% level of completion or higher was considered the benchmark for successfully meeting the standards. For each standard Deerfield Township was determined to be deficient in, a specific recommendation was made which needed to be completed in order to gain compliance with that standard.

Staffing and Deployment Plan

Based on the information gathered during the background research, regional survey, and local analysis, a draft staffing and deployment plan was developed. It included a review of the

current Deerfield Township Fire and Rescue staffing and response procedures, as well as current distribution and deployment of resources. The information gather was applied to existing conditions to locate deficiencies in current procedures. The staffing and deployment plan drawn up addressed deficiencies in current procedures. It identified current strengths and deficiencies, and outlined specific steps which needed to be taken to meet national staffing and deployment standards.

Limitations and Assumptions

This project was undertaken to develop a staffing plan which met the majority of emergency service requests which Deerfield Township faces. There is no way to accurately model every potential set of circumstances which may impact Deerfield Township's ability to deliver service in a timely manner. All staffing and emergency response comparisons made were based on the assumption that units were fully staffed and responding from their assigned quarters. It was also assumed that any mutual aid departments providing emergency response were also responding from their respective station and staffed to their full current assigned level, and that there was no significant delay in the transmission of the alarm to their respective dispatch center.

All data analysis was based on calls answered in 2005, the last full year of data available. All analysis made was based on the data as reported, which is known to contain a potential for inaccuracy. The most significant inaccuracy developed from the fact that all times reported must be entered by the dispatch center and do not auto-populate. None of the Deerfield Township Fire Rescue units were equipped with mobile data computers or transmitters.

The plan developed is based solely on meeting staffing and response standards. It does not include an implementation plan, cost or feasibility analysis. However, it does work from the

premise that existing stations (including one now under development) will continue to be used, and that any future station expansion would have to work around existing stations. The developed plan also relies on automatic aid, and assumes that mutual aid agreements already in place will continue to exist in a similar fashion.

Definition of Terms

Automatic Aid – The response of unit(s) from a mutual aid department to an incident on the initial call, without having to be requested by the responding department.

Benchmark – The measure to which a performance standard is set and its achievement can be marked.

Capability – A department's ability to rapidly deploy resources to an incident.

Capacity – A department's overall staffing ability to deliver an effective number of resources to deal with multiple tasks at a single call or multiple calls simultaneously.

Deployment – The number and type of resources sent to any specific type of incident.

Global Information System (GIS) Mapping – The gathering and use of data from a variety of sources entered into a single computer system for purposes of analysis to create multi-dimensional maps of a community or area.

Hazard Assessment – Evaluation of a specific occupancy (target) to identify dangers associated with its construction and use in determining the number and type of resources necessary to handle an incident.

Initial Response Deployment – The total number or resources dispatched to a specific type of call, based on pre-incident information.

Performance Standard – Identifying a desired outcome based on the audience expected to complete it, the behavior expected, the conditions attached to that outcome, and to what degree the outcome should be performed.

Risk Management – The process of measuring potential gain against the risk required to achieve that gain.

Short-staff – To provide less than the standard or required number of personnel on a company or unit.

Staffing – The overall number of personnel available on-duty at a given time.

Task Analysis – Evaluating an operation to determine the number and type of tasks required to complete the operation, and the number of personnel required to safely and efficiently complete each task.

Unit Staffing – The number of personnel assigned to operate on a single piece of apparatus or company.

Results

A total of seven standards related to the staffing and deployment of EMS/Fire/Rescue personnel to emergency incidents were identified. Only one of these was an adopted measure requiring compliance by Deerfield Township-the Ohio Bureau of Workers' Compensation Ohio Administrative Code 4123:1-21 requiring two-in/two out. Three of the seven were standards developed by the National Fire Protection Association and act as recoginized national standards. Two of the seven contained staffing and deployment measures as part of a department evaluation. The final standard-OSHA's Respiratory Protection Standard-served as a national standard but since Ohio is not an OSHA state compliance was not required (see Appendix A).

While not considered a standard, data was retrieved from the 2002 U.S. Fire Administration's *Needs Assessment for the Fire Service.* Based on the survey, staffing for career department's under 25,000 was 7.3 firefighters on-duty. The number increased to 18.8 for communities with a population of between 25,000 and 50,000. The majority of career departments protecting communities of less than 100,000 do not staff fire companies with four personnel. When compared to the ISO standard of locating fire stations within a 1.5 mile initial response area, less than 12% of departments protecting communities under 100,000 in population meet the standard.

To determine how other department's in Southwest Ohio address staffing and deployment issues a survey was conducted. Inclusion in the survey required a department meet the criteria of being fully staffed, utilize a combination of career and part-time personnel, and

operate from multiple stations. For clarification, part-time personnel fill staffed positions and were paid an hourly wage based on the position and their qualifications, but did not receive benefits. Only Southwest departments were included due to the unique nature of the part-time staffing system found in this area (see Appendix B).

The survey was conducted over the phone with a Chief Officer or Shift Commander. A total of 23 department's in Southwest Ohio were contacted and all agreed to participate. Part 1 of the survey addressed basic community information including the community size and population, overall shift staffing and the number of stations for each department. The 23 departments averaged a staffing total of approximately 12 personnel operating from 3 stations, None of the departments met the personnel to population ratio of 1:1000 (see Appendix C).

The second part of the survey addressed the distribution of resources among their stations, and how department's deployed resources to reported structure fire incidents. None of the departments surveyed utilized a tiered response for reported structure fires that was based on previous target hazard assessments. Each department surveyed indicated each station was staffed with at least a piece of fire apparatus and two personnel. Of the 66 stations identified, only 11 (17%) were staffed with less than four personnel. The majority of departments surveyed (70%) staff every station with a minimum of four personnel. However only four departments (17%) do not require the assigned personnel to cross-staff apparatus.

The majority of department's surveyed utilize automatic aid as part of their initial response deployment. Of the 23 departments, 18 utilize automatic aid on the initial alarm. Of the 5 that don't, 4 deployed at least two engines and a quint/ladder with at least 13 personnel on the initial alarm. Initial alarm staffing ranged from a high of 24 personnel to a low of 6. The average number of personnel included on the initial response was 16.4 When staffing numbers

from the survey were compared to those obtained in the U.S. Fire Administration Need's Assessment, of the 9 communities surveyed with a population between 10,000 and 24, 999, 6 had staffing above the national average. For the 12 surveyed departments between 25,000 and 49,999, only 1 had staffing above the national average.

Deerfield Township response data was broken down several ways to better understand specific facets of the response component of the staffing and deployment issue. For the year 2005, DTFR units responded to a total of 2634 incidents, an average of 220 incidents per month. Overall the department was able to place the first-due unit on-scene within six minutes less than 25% of the time. The six-minute benchmark included dispatch, turnout, and travel time. When evaluated by Zone/District, DTFR's average response time was over 7 ½ minutes. For dispatching purposes, Deerfield Township was divided into 17 response zones/districts (see Appendix E). In only 2 of the 17 were the average response times less than 6 minutes.

The ISO Community Survey of Deerfield Township in 2002 provided more analysis of DTFR's staffing and deployment capabilities. Out of a possible 4.0 points for distribution, DTFR received 2.57 (64%). Two district/zones were identified in the follow-up as being significantly deficient – Zone 5602 (the Business District) and all of the Zone 59 Districts (the Northwest Area). Out of a possible 15 credit points for personnel, DTFR received only 7.69, despite an approved staffing level of 13. The primary reason for this discrepancy was the cross-staffing and lack of assigned personnel to account for call-offs and vacancies (see Appendix F).

The final analysis of current DTFR response addressed its initial response deployment based on 2005 structure fire responses. In 2005, DTFR units responded to a total of 53 structure fires which involved the control of fire to some extent. Of these, 32 were mutual aid and 21 occurred within Deerfield Township. Including automatic aid units, an average of 23 personnel

responded on the initial response, 20 of who were suppression personnel and 3 were command personnel. In more than 75% of incidents reviewed, the first due unit arrived on-scene in under 6 minutes from the initiation of the 9-1-1 call. Over 90% of incidents reviewed saw the initial alarm units on-scene in under 10 minutes from the initiation of the 9-1-1 call (see Appendix G).

The identification of standards saw a total of 32 separate performance standards related to staffing or deployment which need to be met. Of those 32, DTFR currently met only 15 of them. Compliance with those standards was measured against a 90% benchmark completion rate. Measures such as two-in/two-out which were identified in multiple sources were included as part of the analysis only once (see Appendix H).

Based on the identified standards Deerfield Township was deficient in, and the benchmarks required t meet them, statements of compliance were generated. Those statements identified specific recommendations which must be undertaken to bring DTFR into compliance. Recommendations ranged from increasing staffing to updating policies and procedures (see Appendix I).

Based on those recommendations, a draft Emergency Services Staffing and Deployment Plan was created. This plan utilized the identified performance standards to craft a plan allowing DTFR to gain compliance with over 90% of the staffing and deployment standards within a five-year time frame. Each performance standard contained within the plan included a benchmark for measuring DTFR's ability to meet that standard. The plan called for regular analysis of different components of the plan to determine how effective the changes being made were towards meeting national staffing and response standards (see Appendix J).

That staffing plan became the final outcome for this research project. One point that was recognized as part of this process is the varying approaches available for departments seeking to

measure their performance. Some of the benchmarks used in those approaches, while not necessarily in conflict with each other, did present problems in their application. Primary in this was the ability to measure performance in initial unit response. The ISO benchmark of 1.5 miles appeared to be based more in an urban environment while the time-based standard appeared better suited toward a suburban environment. At the same time, the time-based standard presented with the issue of requiring reporting information which was not readily available and required certain assumptions when making response calculations.

Enough data was available to create a staffing and response plan capable of meeting the majority of current staffing and response performance standards. The created plan outlined benchmarks for initial response (distribution and unit staffing), initial alarm response deployment, and overall staffing. Each component of the plan represented a key part of the overall response picture. When met, each standard contained in the plan represented a significant improvement toward the service delivery and firefighter safety capabilities of DTFR. Improved service delivered safely and efficiently has always been considered key to the success of any organization.

Discussion

"The principal resource of a fire department is its highly trained personnel" (Cote, 2005). The ultimate measure of a department is its ability to save lives and property. Because of the multitude of factors involved in saving a life, accurately determining how successful a department is at achieving that measure is difficult to do. The best method a department has to measure its effectiveness is to measure the factor's related delivering the service needed to save a life.

Measuring factors related to staffing and deployment is one method a department has to evaluate its effectiveness. Overall staffing is more than simply a measure of providing a number of personnel. It involves calculations related to call volume, incident distribution, and the ability to handle multiple calls at the same time. Deployment involves maintaining a balance between the rapid response of the first-due unit and deploying an initial alarm response of sufficient size to handle the tasks required.

Balancing all of this is the reality that most departments face: the budget. Given unlimited resources, most if not all fire officials would choose to staff companies to an adequate level and provide an adequate distribution so first-due companies would have minimal travel time to incident scenes. Unfortunately most departments aren't given the option of unlimited resources. In face many departments are asked to choose between adequately staffing their units or adequately distributing them.

It's a choice with potentially tragic results on both sides. If companies are understaffed initial arriving companies are forced to perform in dangerous situations with no safety net, placing firefighters at risk. If companies are consolidated to maintain unit staffing levels response times increase, placing the public at risk. It often comes down to the law of averages. The probability that firefighters are more likely to arrive at an incident quickly enough to save a life is more likely to happen than the potential for a flashover which traps firefighters in the structure. Working against all of this is the prevailing attitude that risk-taking, even unnecessary risk, is what firefighters do. Accepting loss is what the fire service does (Keyson, 2002).

The attempt to create national staffing and deployment standards can only help to have a positive impact of the fire service's effort to provide safe and effective service to the public. While not originally intended as a staffing and deployment mandate, OSHA's *Respiratory*

Protection Standard has actually achieved just that. Unlike most NFPA standards, 29CFR 1910 in all its adopted forms carries the weight of law. Failure to comply with the standards carries punishments and the real potential for significant monetary losses in a subsequent lawsuit for organizations which choose not to follow this requirement.

Still there are departments that continue to resist the potential gain the fire service could achieve if there was universal acceptance of these types of standards. A big part of the problem lies in the difference in staffing between career and volunteer departments. What larger career departments view as a mandate to provide additional funds for their organization is viewed as simply another unfunded mandate for the volunteers. They don't have the ability to get additional funding so they find themselves in an unwinnable position (Baltic, 1998).

The discrepancy within the fire service itself makes the creation of a universally supported and adopted national staffing and deployment standard difficult to achieve. There s no magic formula for determining how many personnel a department should have on-duty, or how many personnel are required to handle each incident type. In a rural environment an EMS unit may be required only one time every two or three days. In an urban setting that same size population may require an EMS unit every two or three hours. Water supply in a suburban community is usually handled with one or two personnel; in a rural setting it likely involves eight to ten.

Since most departments are supported in some form on the basis of taxes, adding additional staffing often becomes a question of what a community is willing to support. Like many issues a variety of facts and formulas, some true some not so true, are used to support opposing positions. There is no magic formula, no set number in stone, which defines that a community of a certain size and population requires a set number of personnel. Like many

issues it comes down to probability – the likelihood that an event will or will not occur (Coleman 2005a).

Deerfield Township finds itself in just such a situation. According to the letters received, DTFR does an excellent job of meeting the needs of the community it serves. Yet research shows it clearly falls short of initial unit response time standards to most areas of the district. As long as DTFR units are handling only one or two calls simultaneously it has the resources necessary. However when multiple calls come in, or the reported structure fire occurs when personnel are already committed on EMS incidents, then the resources are insufficient to meet the need. It's a question of probability.

The research indicates that DTFR is compliant with less than one-half of the national standards related to staffing and deployment. The majority of the compliance issues revolve around the initial response. Personnel are assigned to cross-staff EMS and fire units. As a result the fire companies are not consistently staffed with four personnel, meaning the initial responding fire unit does not arrive consistently arrive with four personnel.

The reason for cross-staffing is a matter of economic probability. Tax dollars provide for only a certain number of on-duty personnel. By cross-staffing a department plays the odds about what type of incident will occur first. With less than six EMS and three fire responses per day the odds are two-to-one that a subsequent incident will be another EMS request. With multiple stations, the odds of the next incident being a fire incident, and occurring within the same first-due area as the previous EMS call are long. Factor in the number of actual structure fires within Deerfield Township each year (21 in 2005), and the probability charts indicate the chance of getting caught short-staffed are long.

What is often overlooked when calculating the odds is how often companies are short-staffed even before the first call. Training, company inspections, and call-offs all result in short-staffed companies. On paper a department appears to be routinely capable of meeting the four-person first-due requirement, when in reality that capability exists for only about two-thirds of the time.

From a risk management perspective this level of risk becomes acceptable when other efforts to obtain additional personnel are not available. The risk potential that exists is increased for firefighters but only if all other factors are aligned in such a way that a working fire occurs in the first-due district where the company is currently short-staffed. The alternative – closing a fire station to guarantee staffing of for other fire companies – comes attached with the risk that is created to the public when no first response capability is available. Since risk is a measure of potential loss vs. probability of occurrence, the risk management approach calls for selecting the option which presents with the least probability of occurring (Kipp & Loflin, 1996).

The other component to the initial response involves meeting the initial response standard. ISO continues to use the 1.5 road mile standard, which would result in the first-due unit arriving within a time frame where they are more likely to have a positive effect on the outcome of the incident. NFPA 1710's six-minute response window is also predicated on meeting that same time frame. Initiating operations within six to eight minutes is an important benchmark because of the extreme effects related to flashover. With a flashover occurring within eight minutes after free-burning begins, a fire department has only that small time frame to control the fire before a flashover occurs. Once flashover has occurred, the probability of making a successful rescue or limiting the structural damage is very limited (Zikmund, 2001).

Using that reasoning the NFPA 1710 initial response benchmark is probably a more accurate representation of DTFR's response capabilities than the ISO response benchmark of 1.5 road miles. The problem with using the ISO benchmark is it doesn't allow for local conditions or out of place units. Compliance is based solely on 90% of the calls occurring within 1.5 miles of a fire station – regardless of whether the crew is actually there or not. A time-based standard also doesn't take into account local road conditions, but it factors out all conditions. From where a company is, split or together, the first-due company has four minutes travel time to arrive on-scene.

When compared to other departments, Deerfield Township is comparable to those defending communities between 25,000 and 50,000 in population. DTFR units deploy from three stations, the same number of stations as the national average. It has four available engines and a quint ladder, both about average. Like most departments its size, DTFR provides EMS, fire, and rescue services. However its current overall staffing level of 14 suppression personnel is a full company below the national average (USFA, 2002).

When compared to other regional departments, Deerfield Township provides a higher staffing level and initial response deployment than similar-sized communities. Survey results indicate the average initial response deployment in between 16 and 17 suppression personnel while DTFR provides 22 to 24. Overall staffing is comparable to similar-sized communities.

Like most departments surveyed, DTFR relies on cross-staffing to provide a balance between first response capability while maintaining a flexible overall capacity to handle multiple, if less manpower-intensive incidents. It is interesting to note that as communities increase in size their dependence on cross-staffing decreases. Since the majority of a

department's call volume is EMS, it is probable that this transformation is a result of the unavailability of personnel assigned to the EMS units to respond to fire incidents.

Deerfield Township's initial response deployment is already above both the national and regional average. However current CAD capabilities cannot differentiate between a fully-staffed and an under-staffed company. As a result, deployment levels can vary even if the initial response of apparatus remains constant. Excluding the one multi-alarm fire, 2005 structural fire deployments ranged from a high of 27 personnel to a low of 16 personnel despite a consistent number of apparatus responding to the incident.

This piece of information points to a significant risk in current initial response deployment practices. Response protocols are often established based on the assumption that every company will be fully staffed. When incidents occur and companies respond without full staffing, the completion of some tasks may be delayed or require the assignment of multiple companies to complete. Using past records to develop a more accurate initial response deployment picture and building CAD tables around those numbers would probably result in more even staffing. This reduces the possibility of task completions being delayed or not completed (Harkes, 2005).

Transitioning from a reliance on cross-staffed companies to fully staffed fire and EMS units will take a significant increase in overall staffing numbers. When compared with other staffing initiatives the benefits do appear to clearly outweigh the challenges. Two other staffing initiatives involve three-person fire companies or consolidated EMS transport. The three person initiative staffs each station with five, with three assigned to the fire company. A three-person fire company can prepare to make entry and then initiate operations once the next company arrives. Consolidated EMS places a single EMS unit first due on all EMS calls, relying on fire

companies to provide first response on all calls. Fire personnel are pulled off a company to handle any subsequent EMS calls.

NFPA 1710 clearly sets the initial response benchmark at four personnel, as does the OSHA two-in/two-out standard. However, neither goes to the point of actually requiring four personnel on an arriving piece of fire apparatus. Even RIT operations are divided into two-person and four-person requirements. Safety advocates continue to stress that a two-person RIT is insufficient to perform an actual firefighter rescue (Hoffmann, 2003a).

The best answer to determining the appropriate company staffing level for a department appears to be completing their own task analysis. Several studies appear to show how company staffing levels affect injury rate, fire loss, and overall firefighter safety. However, there are many factors which may also correlate to these increased rates. Conducting realistic task analysis allows a department to see real-time outcomes for various staffing configurations, and apply them in settings which allow the department to make the most of the resources available to them (Lawrence, 2001).

The draft staffing and deployment plan is a culmination of many of the factors considered within this research. Staffing and deployment plans are at their core an issue of resource allocation and risk management. The proposed staffing and deployment plan helps distribute resources while meeting initial response requirements. If implemented, the plan will significantly shift the risk/benefit probability model in Deerfield Township. Staffing will no longer be the chess game it is now, attempting to out-maneuver future calls against a set number of resources.

The answer to Deerfield Township's staffing issues may eventually lie outside solutions which can be applied within the organization. Any attempt to add personnel – as this plan calls

for – will require a significant increase in department funding. However sound application of the lesson's learned provides a blueprint for the future. Firefighter safety is improved as the first due unit is no longer dependent on not being split when the call comes in. Service delivery is improved as properly distributed resources are more likely to arrive on-scene within the critical six minute time frame. Fire operations are improved as deployment is based on actual, not potential staffing numbers, making task completion more certain.

Adoption of national staffing and deployment benchmarks provides DTFR with clear direction as the organization grows. It provides the public with a better sense of the capabilities of the department. The department is better able to analyze its performance in key service delivery areas. In the end both the safety and efficiency of emergency service delivery is improved.

Recommendations

As a result of this project, the following recommendations based on the information gathered related to the staffing and deployment of fire service personnel to emergency incidents are made:

1. Review each of the actions required for compliance as outlined in Appendix I and develop an implementation strategy for completing each of them. Develop specific benchmarks for compliance in each item identified.

Each of the compliance issues identified is linked to a specific standard on staffing and deployment. As such, these compliance issues are crucial to DTFR's ability to meet national staffing and deployment standards. Several of the compliance issues listed involve internal changes in existing policies and procedures, and can be implemented with little cost.

2. Complete an updated, timed task analysis for structure fire incidents. Use the information collected to create staffing ad deployment standards for individual units and the initial response deployment.

To be truly effective, staffing and deployment numbers must be based on local conditions. This includes a department's ability to complete tasks with a defined number of personnel within a defined period of time. Only a task analysis completed under realistic conditions can provide that information. From this point a department can determine what number of personnel need to be present on each apparatus, how that staffing may or may not need to vary, and the total number of resources required to respond to various types of incidents.

Once the task analysis is complete, target hazard assessment data can be applied to create real-time deployment standards that make-up CAD response tables. Deploying the appropriate number of resources to specific target hazards is the most effective method of ensuring safety and efficiency on the emergency scene.

3. Promote the adoption of the Deerfield Township Fire Rescue Emergency Services Staffing and Deployment Plan, 2007 – 2012. This plan has been created based on the latest available data as applied to existing national staffing and deployment standards. It provides DTFR with the resources necessary to deliver a rapid and effective response to all types of emergencies. Its adoption and implementation will allow DTFR the best opportunity for meeting national standards for staffing and deployment.

References

American Heart Association (2006). *Out of Hospital Cardiac Arrest.* Retrieved May 12, 2006, from http://www.americanheartassociation.org/downloadable/heart/1136822850501OutofHosCA06.pdf.

Avillo, Anthony (2002). *Fireground Strategies*. Tulsa, OK: Pennwell Publishing.

Baltic, Scott (1998). Three to Get Ready, Four to Go. *Fire Chief*: 42(9), 44-50.

Bingham, Robert C. (2004). *Street Smart Firefighting.* Vienna, VA: Valley Press.

Brunacini, Alan V. (2002). *Fire Command, 2nd Ed.* Phoenix, AZ: Heritage Publishers.

Cardwell, Michael (2005). *A Regional Approach to Incident Command*. An Applied Research Project. Emmitsburg, MD.

Carter, Harry R., & Rausch, Erwin (1999). *Management in the Fire Service.* Quincy, MA: National Fire Protection Association.

Coleman, Ronny J. (2003a). Magic Numbers Do Departments No Favors. *Fire Chief:* 49(7), 30-36.

Coleman, Ronny J. (2003b). Taking Full Advantage of Fire's Diamond Time. *Fire Chief*: 49(10), 30-34.

Commission on Fire Accreditation International (1997). *Fire and Emergency Self-Assessment Manual, 3rd Ed*. Fairfax, VA: Author.

Cote, Arthur E. (2002). *Fire Protection Handbook*. Quincy, MA: National Fire Protection Association.

DeLuca, Chuck (2003). Understaffed Engine Company Operations at Residential Fires. *Fire Engineering:* 156(2), 110-111.

Drysdale, Dougal (1999). *An Introduction to Fire Dynamics*. New York: John Wiley & Sons.

Harkes, Jim (2005). Playing the Numbers Game. *Fire Rescue:* 23(3), 78-83.

Hoffmann, John W. (2003a). "Front-Loading" For Firefighter Safety. *Health & Safety*: 14(4), 1-12.

Hoffmann, John W. (2003b). Is Short-Staffing Fire Companies with 3 Firefighters Safe And Efficient? *Health & Safety*: 14(8), 7-9.

Insurance Services Office (1980). *Fire Suppression Rating Schedule*. Marlton, NJ: Author.

Insurance Services Office (2002). *Public Protection Classification Survey Report: Deerfield Township, Ohio*. Marlton, NJ: Author.

Johnson, Russ (2004). Deployment Matters. *Fire Chief:* 48(3), 78-79.

Keyson, Lauren (2002). Weak Training + Weak Staffing = Disaster in Waiting: An Interview with William Goldfeder, Battalion Chief, Loveland-Symmes (OH) Fire Department. *Fire Engineering:* 155(7), 90-93.

Kipp, Jonathan D., & Loflin, Murrey E.(1996). *Emergency Incident Risk Management.* New York: Van Nostrand Reinhold.

Kroboth, Joe III (2003). *Developing and Evaluating Response Time Criteria.* An Applied Research Project. Emmitsburg, MD.

Lawrence, Cortez (2001). Fire Company Staffing Requirements: An Analytic Approach. *Fire Technology:* 37(3), 199-218.

Morris, Gary (2005). Too Little, Too Late. *Fire Chief*: 49(9), 62-66.

National Fire Protection Association (2005a). *NFPA 1410: Standard on Training For*

Initial Emergency Scene Operations, 2005 Ed. Quincy, MA: Author.

National Fire Protection Association (2005b). *NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs, 2002 Ed*. Quincy, MA: Author.

National Fire Protection Association (2005c). *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, 2004 Ed.* Quincy, MA: Author.

Newspaper Finds Deadly Delays in Response. (2005). Retrieved May 12, 2006, from http://www.firechief.com/mag/firefighting_newspaper_finds_deadly030105/index.html.

Ohio Bureau of Workers' Compensation (2003). *Specific Safety Requirements of the Bureau of Workers' Compensation Division of Safety and Hygiene, Chapter 4123:1-21: Fire Fighting.* Columbus, OH; Author.

Pegram, Steve N.(2001). Number Crunch: How Many Firefighters Does it Take to Knock Out a Structure Fire? *Fire Rescue*: 19(7), 27.

Routley, J. Gordon (2004). National Fallen Firefighters Foundation Firefighter Life Safety Summit Report. *Firehouse*: 29(6), 40-42.

Scott, Michael (2002). Safety: The Mandate of Change. *Health & Safety*: 13(9), 1-14.

Staffing Tops Chiefs' Worries. (2006). Retrieved May 12, 2006, from http://www.firefhief.com/mag/firefighting_staffing_tops_chiefs/index.html.

Turner, Robert Lee (2004). *The Jefferson City Fire Department Staffing Study: Are We Protecting Our Citizens?* An Applied Research Project. Emmitsburg, MD.

U.S. Fire Administration (2002). *A Needs Assessment of the U.S. Fire Service.* Washington D.C.: Author.

Vatter, Michael J. (1998). *Firefighter Safety: An Infernal Analysis of the Relationship Between Staffing Levels, Fire Severity, and Injuries.* An Applied Research Project. Emmitsburg, MD.

Weiger, Pam (2004). A SAFER Beginning. *NFPA Journal:* 98(1), 46-51.

Zikmund, Nyle (2001). Response Research Indicates Time for a Change. *American Fire Journal:* 56(6), 30-32.