

FIRE SERVICE PERFORMANCE MEASURES

Jennifer D. Flynn

November 2009



**National Fire Protection Association
Fire Analysis and Research Division**

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Abstract

This report identifies and presents potential performance measures as they relate to the core functions of the fire department and discusses the information garnered from and the cautions associated with each measure.

Keywords: Performance Measures, Fire Service, EMS, False Alarms

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Fire Service Performance Measures

Performance measurement is a popular buzz phrase circulating around departments, cities, and towns, but it is not new to the fire service. Performance measurement relies on the evaluation of achieved outcomes, compared to desired outcomes. For the fire service, the desired fire protection outcomes - which are not easily measured - include fires prevented or suppressed, and ultimately the human life and property preserved (Hatry).

Many departments have expanded their services to include emergency medical service (EMS), emergency management and homeland security, hazardous materials response, and other emergency and non-emergency calls. In addition to these responsibilities, fire departments often perform fire prevention inspections, review plans, and work with a number of other non-fire agencies.

There are several studies, some of which date back to the 1970's, that highlight important performance measures for fire departments to consider when evaluating workload, performance, efficiency, and effectiveness.

There have been some key changes in fire codes since the 1970's. This can have an impact on measures of fire department performance. Fire detection and suppression equipment is now required in most new construction. There are more flammability requirements for building contents, such as upholstered furniture and mattresses and bedding. Space heaters and many home appliances such as irons or coffee makers now have requirements to automatically shut off if they tip or are left on for an extended period of time. These are all things to keep in mind when developing measures and examining performance over extended periods of time.

But, why measure performance? Robert Behn points out, "neither the act of measuring performance nor the resulting data accomplishes anything itself; only when someone uses these measures in some way do they accomplish something." He goes on to suggest that public managers have an ultimate purpose of using measures to improve performance, with

The following list is a selection of important research that has been conducted in the area of fire department performance measures. These have been suggested to the author by various individuals and experts that are interested in this subject. The literature, research, and examples of measures are not limited to these.

1. ***Measuring Fire Protection Productivity in Local Government*** by the National Fire Protection Association and Urban Institute (NFPA/UI,) 1974

This report discusses measurements for fire protection productivity analysis and comparison. The authors define productivity as the output delivered relative to the amount of input resources available. Output includes consideration of the quality and effectiveness of the service as well as the workload.

2. ***Procedures for Improving the Measurement of Local Fire Protection Effectiveness*** by the National Fire Protection Association and Urban Institute (NFPA/UI,) 1976

This study was conducted to develop and test improved procedures for measuring fire service outcomes and effectiveness. It focuses on some of the measures in *Measuring Fire Protection Productivity in Local Government* and fills in some of the information gaps in that study.

seven other purposes as a means to achieve that. The seven other purposes are to (1) evaluate, (2) control, (3) budget, (4) motivate, (5) promote, (6) celebrate, and (7) learn (Behn).

You cannot measure a program without first clearly identifying the goals and purpose of that program, in other words the intended outcome. Goal statements are qualitative statements that typically generalize the intended outcome of a program in words rather than numbers. This is the first step to evaluating performance. Once intended goals are established, the department must identify the functions or actions that are taken in order to achieve said goal. They must also consider available resources - whether monetary, equipment, or person-hours. The *Fire and Emergency Service Self-Assessment Manual*, by the Center for Public Safety Excellence and Commission on Fire Accreditation International is a good example of how to create goals statements and measure the achievement of those goals.

Performance measures are the quantitative or numerical representation of activities and resources that help evaluate whether the goal is met.

The easiest and best way of applying quantitative performance measures to qualitative goal statements is to specifically identify target rates or percentages for each goal. For example, one qualitative goal statement for the fire department might be to “control fire spread upon arrival.” The department could use the measure: percentage of fires that did not spread beyond the area of origin after arrival of the fire department. When talking to public administrators and town officials, saying 88% of fires did not spread beyond the area of origin after fire department arrival doesn’t really mean much without an identified target goal. Of course, ideally everyone wants 100% of fires confined to the area of origin, but it is not always the case. Realistic target goals should be set.

According to The Rand Fire Project, any public service must be measured by its effectiveness, efficiency, and equity.

3. ***Fire Department Deployment Analysis: A Public Policy Analysis Case Study***, The Rand Fire Project, Chaiken and Ignall, 1979

This project offers an examination of how systems analysis can be applied to public policy issues of fire department deployment. It includes in-depth measures of deployment, response time, and fire station relocation.

4. ***Measuring Code Compliance Effectiveness for Fire-Related Portions of Codes*** by the National Fire Protection Association and Fire Protection Research Foundation (NFPA/FPRF,) 2008

This report discusses measurements specifically for analyzing the effectiveness of fire inspection programs. This report identifies eleven core measures.

5. ***How Effective Are Your Community Services? Procedures for Performance Measurement***, by the International City/County Management Association (ICMA,) 2006

Chapter 6 of this book offers measures for fire protection from the perspective of the city manager. This chapter also provides information on where data can be obtained and how it should be analyzed. Measures are for fire protection and EMS.

6. ***Fire and Emergency Service Self-Assessment Manual***, Center for Public Safety Excellence and Commission on Fire Accreditation, 2009

Guide for self-assessment and improvement for fire departments.

Effectiveness is concerned with the basic reason for providing the service. Measures of effectiveness determine how well a service does what it is supposed to do. To determine effectiveness, it's important to look beyond immediate output and determine the associated consequences of that output. Efficiency is concerned with how well resources are used in providing the service. Efficiency measures are an economic criterion, most often associated with money. Equity is concerned with the relationship between those who pay and those who benefit. Equity measures look at the fairness in levels of service provided and citizen expectation (Chaiken and Ignall).

Once goals, department functions, measures, and, targets have been identified then the department can begin benchmarking.

7. ***Organizational Benchmarking and Performance Evaluation*** by Dorinda Cline, published in the *NFPA Fire Protection Handbook*, 2008

Chapter 2 of section 12 in the NFPA Fire Protection Handbook discusses fire department performance evaluation and benchmarking from a systems perspective. This chapter includes information on factors that affect organizational acceptance of performance management concepts and integrating such a system into the fire service organization.

8. ***Fire Suppression Rating Schedule Handbook***, Harry Hickey, Insurance Services Office (ISO), Inc., 2009

The Fire Suppression Rating Schedule (FSRS) is the manual ISO uses to review fire-fighting capabilities of individual communities. The handbook provides material to improve Fire Chiefs and municipal administrators understanding of the ISO's process and procedures for conducting grading evaluation fire protection districts with respect to their capability to suppress structural fires.

9. ***Model Performance Measures for Fire Prevention Programs***, Vision 20/20 National Strategies for Fire Loss Prevention, March 2009

“This project outlines potential model performance measures for local, state, and national fire prevention program managers. The goal is to begin reporting fire prevention efforts in a consistent enough fashion to allow for legitimate program comparison and the establishment of both baseline performance measures and benchmark standards ”

Benchmarking

Comparing Performance and Benchmarking

Each measure is defined as a number or percentage, but what does that percentage tell you?

When evaluating performance it is important to compare current performance to past performance and to target goals. This may mean evaluating performance seasonally, quarterly, or annually. Internal, historical comparison would reveal whether or not improvement has been made, but will not evaluate the adequacy of performance (Ammons).

Comparing performance to a standard performance level, also known as a benchmark, would assess the adequacy of local operations (Ammons). The term “benchmark” refers to the standard to which we measure, but also denotes the search for best practices. Benchmarks vary and can be based on technical standards, historical data, comparables from similar departments, or specific organizational priorities (Cline). For most performance measures, there is no natural target and no consensus or legal standard to meet. This leaves benchmarking, which is a standard based on the best levels of performance achieved by comparable departments.

The Governmental Accounting Standards Board (GASB) encourages municipalities to compare performance against other municipalities (Ammons). Schaenman and Swartz agree, but also suggest that performance measures can be used to assess fire service productivity between cities and nationwide.

When performed correctly, this type of analysis can be very beneficial in determining how fire departments can operate more efficiently and effectively. Performance analysis can also be used during the budget process, indicating what resources are available and what resources are needed.

Things to consider before choosing a “similar” city to compare performance against

Performance measures can be used for comparing performance against standard benchmarks and inter-city comparisons of similar communities based on geographic size, climate, or population protected. However, there is no single characteristic that is a standard identifier for what constitutes a “similar” community.

When comparing one department’s performance to another department’s performance, it is important that the two departments match on the key characteristics that define the

The following factors or points are only a few examples of the things to consider for comparison before choosing a benchmarking partner:

- Socioeconomic factors, such as population education level or median household income.
- Climatic conditions, such as heating degree days-measure of time spent fighting fires under freezing conditions.
- Community layout and traffic
- Construction, including age profile of buildings and type of construction.
- Makeup of community, (e.g., residential, commercial, and industrial)

departments as similar. One characteristic might be department size - selecting a neighboring department of similar size. This typically is an easier exercise for smaller departments. Departments that protect larger populations are few in number and so will most likely have to look farther for comparable jurisdictions. Population protected is not the only characteristic that departments rely on to consider themselves similar. Climate type, geography of the land protected, types of hazards, the demographics of the population protected, or even budget constraints of the city protected/department are all characteristics that contribute to the similarities of like departments.

Even though departments may share similar qualities or community factors, the goal level of service provided may be different. In *Service Quality and Benchmarking the Performance of Municipal Services*, Folz suggests that local officials can better select adequate benchmarking partners by establishing a target level of service quality and comparing the department's performance to other departments that measure themselves against the same target. This method of selecting benchmarking practices identifies successful programs and allows for other programs to improve their own practices by lessening the gap in performance (Folz).

Things to consider when comparing measures.

Cline put it best when she said “the decision about how to use benchmarking goes back to the practice that best matches the philosophy, culture, and mission of the organization. There is an abundance of things to measure and benchmark in a fire department. The key to providing information and not just numbers lies in the selection of what to count and which yardstick to use to create a context that has meaning” (Cline).

If measures are to be reliable and truly comparable, there must be agreements on what to measure and how to measure it. Make sure that the comparable community is using the same measures and methods of calculating measures when comparing results.

Communities aren't static; they grow and change over time. Population size and characteristics can change. Building types and construction materials can change. A change in department policy (i.e., personnel levels, inspection frequency) can affect performance. The fire department should take all of these issues into consideration and compare its own community's characteristics and department policy over time.

Fire Service Functions

Fire department performance measures are typically organized and presented into common evaluation term groupings. This report identifies and presents potential performance measures as they relate to the core functions of the fire department and discusses the information garnered from and the cautions associated with each measure. When evaluating department performance, it's important to use several measures together, rather than isolating a single measure. This will help paint a comprehensive picture of the department and performance.

There are four major response types that are made by fire departments.

The four major response types include: fire incident calls, EMS calls, HazMat calls, and other calls such as service calls, or false alarms. Figure 1 identifies the core responsibilities and functions of a fire department.

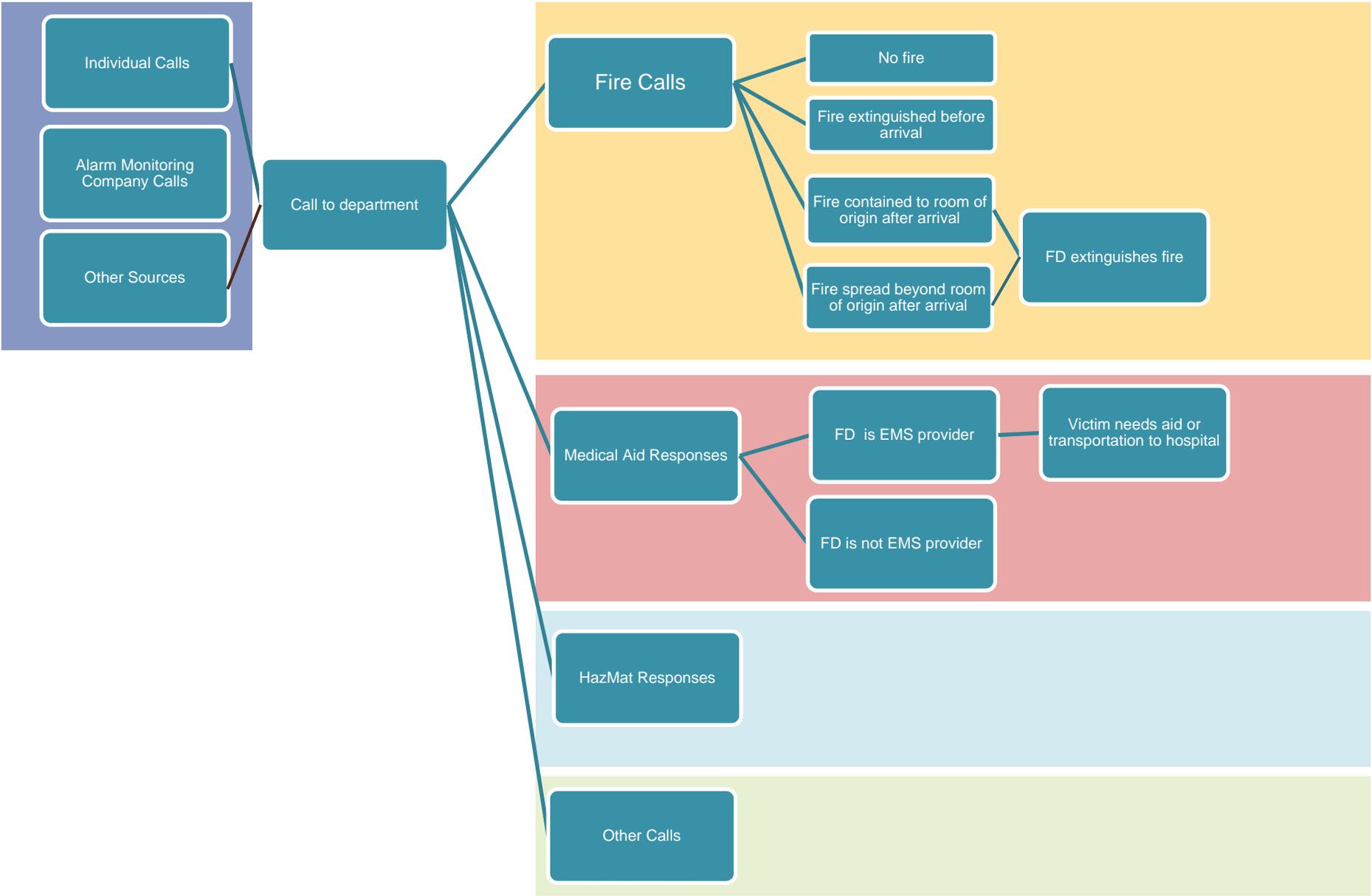
Operations and functions may vary between departments. While 43.8% of departments in the nation provide emergency medical service (Karter & Stein), departments that do not provide EMS would not use the performance measures associated with EMS response. However, this information could be used as food for thought by departments considering taking on this role.

Table 1 is a breakdown of fire department response by incident type and population protected. This table uses annual averages from 2007-2008 and was taken from the NFPA report *Fire Loss in the U.S. 2008*. (Karter)

**Table 1. Fire Department Response by Incident Type and Population Protected
2007-2008 Annual Averages**

	1,000,000 or more	500,000 to 999,999	250,000 to 499,999	100,000 to 249,999	50,000 to 99,999	25,000 to 49,999	10,000 to 24,999	5,000 to 9,999	2,500 to 4,999	Under 2,500
Fire incidents	3.5%	3.6%	3.7%	4.1%	3.8%	5.0%	5.6%	8.6%	11.7%	17.6%
Rescue, EMS incidents	71.8%	66.1%	67.0%	69.3%	65.9%	62.6%	61.1%	55.1%	50.0%	50.2%
False alarm responses	11.0%	6.5%	7.1%	7.7%	9.0%	10.5%	9.5%	9.8%	7.7%	7.1%
Mutual aid responses	0.8%	2.0%	1.2%	2.4%	2.4%	4.0%	6.4%	10.2%	12.4%	13.3%
Hazardous materials	0.6%	0.8%	1.1%	1.1%	1.5%	1.9%	2.2%	2.1%	1.6%	1.0%
Other hazardous	1.5%	1.6%	2.2%	1.9%	2.7%	3.2%	3.5%	3.6%	3.6%	3.0%
All other responses	13.6%	15.1%	17.9%	15.6%	14.0%	14.4%	12.8%	12.0%	9.9%	8.5%

Figure 1. Fire Service Functions when Emergency Call is Received



Fire Service Performance Measures by Department Function

The remainder of this report is organized by specific department function, or response type. Each major area of services is examined independently of other functions and has performance measures that are tailored to that specific service and are highlighted in minitables.

In some cases, but not all, a particular NFPA standard can be used as a benchmark or recommended standard. The mini-tables will contain a box and description of the NFPA recommendation, where applicable.

The National Fire Incident Reporting System (NFIRS) is administered by the U.S. Fire Administration. It is the largest incident based data base of its kind and can be used as an evaluation tool by fire departments. Departments can use this data base to maintain incident records and analyze their own performance. The mini-tables will also contain a box and description of the NFIRS variable that corresponds to that measure, where applicable.

Sources of Incident Calls

Calls to fire departments can come in from many avenues. Individuals and alarm monitoring services are the major sources for calls to fire departments. The fire department has no direct involvement in how quickly a fire is discovered once it starts and how promptly the fire is reported once it has been discovered. In the best case scenario, someone notices a fire when it starts and reports the fire immediately after evacuating, but this does not always happen.

Guylène Proulx wrote that when people hear fire or smoke alarms, their first response is typically to try to find the reason for the alarm rather than immediately escaping or reporting a fire. In some situations, no one is present to hear an alarm or if they do hear it, they may choose to ignore it entirely. If they realize it is a fire, they may try to fight it themselves, warn or assist others, or collect belongings (Proulx).

According to the NFPA report, *Smoke Alarms in U.S. Home Fires*, 40% of the non-fatal civilian injuries in home fires with working smoke alarms were incurred while the individual was trying to control the fire, compared to 30% of injuries in which no smoke alarm was present and 34% in which smoke alarms did not operate (non-confined fires only) (Ahrens).

In a situation where an alarm monitoring company alerts the fire department to a fire, a fire had to become large enough to activate the alarm. The alarm alerts the monitoring service who then contacts the fire department.

PMI. Source of Call

Measures	Discussion
% of calls from individuals (stratify by call type-fire, medical, other, etc)	The source of the incident call can affect the total response time from fire start to department response. This measure can be used in concert with a measure of average response time. This will help identify if the call source is or is not impacting the fire spread outcome. Alternatively, departments could analyze response time separately by source of call. This will related combined response time to percentage of calls by source.
% of calls from alarm monitoring companies (stratify by call type-fire, medical, other, etc)	
% of calls from some other source (stratify by call type-fire, medical, other, etc)	

In her article about response to fire alarms, Proulx notes that the type of building in which a fire alarm activates is a key factor in the way people respond. Typically, an alarm in a home leads to a very fast response by occupants while response to an alarm in a public assembly occupancy could be expected to be slow (Proulx). This suggests that source of call measures stratified by occupancy type would be informative in examining total response time measures.

Fire spread may also be affected by fire notification and dispatch.

The more time it takes to notify the fire department, the more time fire has to spread. However, monitoring services may be more likely than individuals to report confined fires, since individuals are likely to put these minor fires out themselves. To identify this, the source of the call would have to be examined along with fire spread.

Compared to all buildings, a building with an alarm monitoring system may be more likely to be equipped with an automatic fire detection and/or suppression system, which would increase the likelihood that a fire would be detected early or contained to the room of origin. The measure might be further strengthened by examining the percentage of calls made by either individuals or alarm monitoring services by presence or absence of automatic suppression systems.

Fire incident calls, by definition, are the fire department’s primary mission and the majority of performance measure research focuses on this function. The following measures are for incidents in which fire was present or had been present upon fire department arrival. Measures for false alarm and nuisance alarm responses are included in the section: Other Calls.

Fire incidents include fires that involve structures, vehicles, wildland areas, and rubbish or trash. The department should examine their performance in each of these scenarios, rather than taking an overall approach to identifying performance in all fire incident calls as a collective.

Fire departments may arrive to several different scenarios at a fire scene.

Fire scene scenarios include: fire extinguished before arrival of firefighters, fire contained to the room of origin before or after arrival of firefighters, or fire spread beyond room of origin before or after arrival of firefighters. In some scenarios, a person may need to be rescued from a building or fire scene. There may also be fatalities or injured victims on scene who require medical aid.

PM2. Fire Rate

Measure	Discussion	NFIRS Variable
# of reported fires/1,000 population # of reported fires/1,000 buildings (by occupancy)	Fire prevention is an important function of fire departments. Ideally, the department would want to measure how many fires have been prevented, but that is not possible. Instead, fire departments can use fire rate measures of reported fires by population or by buildings.	NFIRS incident type 100-199 in the basic module captures structure fires, vehicle fires, and outside and other fires. Departments should use totals and stratify fire rates by category-structure, vehicle, outside. This stratification should be used with every measure related to fire incident calls.

After testing fire-rate measures in nine communities, Schaenman, Hall, et. al suggested adjustments to it.

1. Fire departments should count larger, more serious fires (in addition to usual tallies) separately from very small, no-casualty fires.
2. Fire departments should compare actual fire rates to expected fire rates. They should also assess the community for characteristics that are associated with high fire incident rates.

Fire rate by population size is potentially misleading in communities that experience very different day and night populations. For example, a city with many businesses and a low resident population might appear to have higher fire rates because the additional nonresident population is generally not included when calculating fire experience rates by population. (Schaenman and Swartz).

PM3. Response and Control Times - Fire Incident Calls

Measures	Discussion	NFPA Standards	NFIRS Variables
Times should be stratified into: <ol style="list-style-type: none"> 1. Turnout time 2. Travel time 3. Total response time 4. Time of control of fire* 	Shorter response times can usually be expected in urban areas compared to rural areas, due to the size of the community, number of facilities, such as fire stations, population and resources within the community. This needs to be taken into consideration when comparing response time performance across communities.	NFPA 1710 (Career) recommends 80 seconds for turnout time for fire and special operations response	NFIRS dates and times are numerically entered values in the basic module.
Average response time per fire incident call		For the initial arriving company, the fire department's fire suppression resources shall be deployed to provide for the arrival of an engine company within a 240-second travel time to 90% of the incidents.	<u>Variables include:</u> Alarm time Arrival time Time when fire is controlled
% of times that are less than "x" minutes		<u>These can be used to calculate:</u> <ol style="list-style-type: none"> 1. Total response time (Arrival minus Alarm) 2. Time to control the fire (Controlled time minus Arrival) 	
% of times that are more than "x" minutes			
Average time to control spread or confirm spread has stopped, by size on arrival and type of occupancy			NFPA 1720 (Volunteer) makes recommendations for meeting objectives based on the population per square mile of the community.
*This is time from arrival to fire control, not the point in time where control occurs			

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* is the standard for deployment for career fire departments, while NFPA 1720: *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments* applies to volunteers. According to NFPA 1720, a volunteer fire department is a fire department having volunteer emergency service personnel comprising 85% majority of either volunteer or career membership. A combination fire department is a fire department having emergency service personnel comprising less than 85% majority of either volunteer or career membership.

It is up to the authority having jurisdiction to determine which, if either, standard is applicable to them.

NFPA 1710 defines time segments as:

Turnout time- The time interval that begins with notification of the emergency response facilities (ERFs) and emergency response units (ERUs) by either an audible alarm or visual annunciation or both and ends at the beginning point of travel time.

NFPA 1710 also recommends that turnout time for fire incidents should take 80 seconds and response time to an incident, by the initial arriving company, be 4 minutes or fewer. There are no recommendations for setup and fire extinguishment time. Measurements of time can be examined in concert with measures of fire spread to determine the effects of response time on fire spread. The same scale that is used to define spread at arrival should be used for measures of extinguishment time.

Travel time- The time interval that begins when a unit is en route to the emergency incident and ends when the unit arrives at the scene.

Total response time- The time interval from the receipt of the alarm at the primary public safety answering point (PSAP) to when the first emergency response unit is initiating action or intervening to control the incident.

USFA’s report, *Structure Fire Response Times*, has a useful framework for total response time definitions and components. The same article notes that 51% of structure fires confined to room of origin and floor of origin had response times of less than 5 minutes, while 54% of fires confined to building and 49% beyond building had response times of less than 6 minutes.

NFPA 1720 recommends the following staffing and response times:

Table 4.3.2 Staffing and Response Time

Demand Zone ^a	Demographics	Minimum Staff to Respond ^b	Response Time (minutes) ^c	Meets Objective (%)
Urban area	>1000 people/mi ²	15	9	90
Suburban area	500–1000 people/mi ²	10	10	80
Rural area	<500 people/mi ²	6	14	80
Remote area	Travel distance ≥ 8 mi	4	Directly dependent on travel distance	90
Special risks	Determined by AHJ	Determined by AHJ based on risk	Determined by AHJ	90

^a A jurisdiction can have more than one demand zone.

^b Minimum staffing includes members responding from the AHJ’s department and automatic aid

^c Response time begins upon completion of the dispatch notification and ends at the time interval shown in the table.

According to NFPA 1720, this table should be used the authority having jurisdiction to determine staffing and response time objectives for structural fire fighting, based on a low-hazard occupancy such as a 2,000 ft² two-story, single-family home without basement and exposures and the percentage accomplishment of those objectives for reporting purposes.

The length of the elapsed time from fire start until fire suppression depends on several factors that may or may not be controllable by fire departments.

In their discussion of productivity measures for fire departments, Schaenman and Swartz suggest that faster response time results in less loss, all other things being equal, and that citizens see fire department response ultimately as the responsiveness of the government and indicative of their own security. Response time can depend on when the fire starts, when it is detected, how efficiently the firefighters prepare for and head to the fire, traffic conditions, and weather (Schaenman and Swartz).

The authors state that a large part of the fire service contribution to reducing loss can be measured by combining response time measures with measures of fire spread after arrival of the fire department. They also suggest analyzing the crash rate en route to or from fires to indicate if response times are being achieved at the expense of increased en route damage and casualties (Schaenman and Swartz). It should be noted that this report was published in 1976, before automatic fire detection and fire suppression equipment were as widely used.

PM4. Fire Spread

Measure	Discussion	NFIRS Variables
% of fires extinguished before department arrival	A high percentage of fires extinguished before departments arrive might show successful campaigns for fire detection and/or fire sprinkler installations.	In NFIRS, fire spread is captured in the structure fire module. This variable only applies to incident types 100-129. This information is not required for fires reported as incident type 113-118 (confined fires).
% of fires not extinguished before department arrival		
% of fires responded to that spread beyond room of origin before fire department arrival	By removing fires that were extinguished before arrival, the fire department is able to actually measure the effect of their actions taken.	Fire spread is defined as the extent of fire spread in terms of how far the flame damage extended. This includes areas that are actually burned or charred, but not areas receiving only heat, smoke or water damage.
% of total fires responded to that spread beyond room of origin after fire department arrival	Accelerants or the presence of hazardous materials can contribute to fire spread and these factors should be taken into consideration when possible.	In NFIRS, fire spread is recorded as the final spread area after the fire has been extinguished. There is no record in NFIRS for where the fire was upon firefighter arrival.

Measures of fire spread at arrival and control have proven and demonstrated face validity.

In *Procedures for Improving the Measurement of Local Fire Protection Effectiveness*, Schaenman, Hall, et. al, tested some measures put forth by Schaenman and Swartz in *Measuring Fire Protection Productivity in Local Government*. The authors found that measures of fire size, spread, and time to control had demonstrated face validity as measures of procedures, but that their impact on policy changes is uncertain. Fire officials must decide the minimum amount of fire spread (and fire size) that is significant for a particular type of decision. This point also applies to measures of fire rates, dollar losses, and fire causes (Schaenman, Hall, et. al).

Fire detection and fire suppression systems are more prevalent in buildings than they were at the time Schaenman, Hall, et. al published their findings and recommendations. Fire departments may want to look at fire spread at arrival and after arrival by presence of fire detection and/or fire suppression systems. This measure would help identify the success of fire detection and fire suppression equipment installation campaigns and fire protection code adoption and compliance.

Varying construction features make comparisons of “fire spread beyond compartment” difficult.

It is difficult to compare measures of “fire spread beyond compartment” because of the variability in construction features, i.e. balloon construction, exposed truss, false ceilings. In

addition to construction features, contents, such as fire load and interior finishes, have a big effect on fire spread. Comparing reports can be very misleading without knowledge of construction materials.

Water supply and fire department staffing capabilities and demographics (career vs. volunteer force) should also be taken into consideration with regards to this measure.

PM5. Civilian Fire Death and Injury Rate - Fire Incident Calls

Measure	Discussion	NFIRS Variable
# of civilian deaths (or injuries)/100,000 population # of civilian deaths (injuries)/1,000 fires	Fire rescue and public education programs affect these measures and can be evaluated by them. Death rates can be problematic for analysis because most communities and even many states do not have enough fire deaths to compensate for generic fluctuations.	Casualty data is collected in the basic module of NFIRS. Civilian deaths and civilian injuries are recorded as numeric values. Remember to limit analysis to incident type 100-199 for fires. Stratify categories-structure fires, vehicle fires, outside and other fires.

Analysis of overall civilian death and injury rates by population size is potentially misleading in communities that experience very different day and night populations. For example, a city with many businesses and a low resident population might appear to have higher casualty rates because the additional nonresident population is generally not included when calculating fire experience rates by population. (Schaenman and Swartz).

It is recommended that departments look at civilian fire death and injury rates by residential and nonresidential population. The residential rates may indicate the effectiveness of public education programs within the community and the nonresidential rates may indicate the effectiveness of fire rescue on scene (Schaenman and Swartz).

Schaenman and Swartz also suggest making a distinction between resident death and injury rates and nonresident death and injury rates. The residential rates reflect the effectiveness of public fire prevention education programs and the nonresidential rates reflect the effectiveness of the local fire code and its enforcement (Schaenman and Swartz). With the increased prevalence of fire detection and suppression systems in buildings and changes to fire codes such as increased flammability standards, it is possible that public education programs may not be the primary driver.

PM6. Firefighter Death and Injury Rate - Fire Incident Calls

Measure	Discussion	NFIRS Variable
<p># of firefighter fatalities (injuries)/1,000 fire fighters</p> <p># of firefighter fatalities (injuries)/1,000 fires</p>	<p>These measures identify the relative risk that departments face. On scene firefighter injuries and deaths are bad on their own, but there is also a potential that suppression is affected.</p> <p>On scene firefighter injuries and deaths impact the suppression of the fire, fire department expenditures-medical bills and workers' compensation, and staffing, all of which ultimately impact fire department performance.</p> <p>As with fire spread, it may make sense to distinguish between all injuries, and injuries requiring treatment or resulting in lost time.</p> <p>The presence of EMS personnel onsite can impact the severity of an injury.</p>	<p>Casualty data is collected in the basic module of NFIRS.</p> <p>Fire Service deaths and civilian injuries are recorded as numeric values.</p> <p>Remember to limit analysis to incident type 100-199 for fires. Stratify categories-structure fires, vehicle fires, outside and other fires.</p>

Firefighter injury rates are impacted by community size and region.

NFPA's report, *U.S. Firefighter Injuries-2008* shows average injury rate distribution by size of population protected and by region. (See Tables 2 and 3)

The Northeast reported a higher number of fireground injuries per 100 fires for most community sizes where all departments reported sufficient data by region. The overall rate for the Northeast was 5.5 injuries per 100 fires, more than twice the rate for the rest of the country. (See Table 2)

Larger departments generally had the highest rates of firefighter injuries with departments protecting communities of 250,000 to 499,999 having the highest rate with 7.9 injuries per 100 firefighters. As community size decreases, the rate drops quite steadily to a low of 0.9 for departments protecting less than 2,500 people. (See Table 3)

Karter explains the difference, "although a department protecting a community with a population of 250,000 to 499,999 has, on average, more than 22 times as many firefighters than a department protecting a population of less than 2,500, the larger department attends more than 100 times as many fires, and as a result, it incurs considerably more fireground injuries" (Karter and Molis).

Table 2. Average Number of Fires and Fireground Injuries per Department and Injuries per 100 Fires, by Population of Community Protected and Region, 2008

Column 1: Average Reported Number of Fires
Column 2: Average Reported Number of Fireground Injuries
Column 3: Number of Fireground Injuries per 100 Fires

Population of Community Protected	Northeast			Midwest			South			West		
	Column 1	Column 2	Column 3									
500,000 to 999,999	*	*	*	*	*	*	3,143.3	41.8	1.3	2,562.2	47.2	1.8
250,000 to 499,999	*	*	*	1,537.3	84.0	5.8	1,152.1	36.3	3.2	1,037.7	17.0	1.6
100,000 to 249,999	540.3	30.2	5.5	541.2	18.4	3.4	670.5	7.3	1.1	383.2	8.2	2.1
50,000 to 99,999	291.2	11.6	4.0	188.9	4.9	2.5	315.5	8.0	2.5	186.3	4.2	2.3
25,999 to 49,999	145.3	5.6	3.9	108.9	2.5	2.3	165.1	2.2	1.3	131.8	1.6	1.2
10,000 to 24,999	60.8	1.5	2.5	54.9	1.1	2.0	86.1	0.8	0.9	59.7	0.6	1.0
5,000 to 9,999	32.5	0.5	1.5	31.9	0.5	1.6	51.2	0.4	0.8	48.7	0.8	1.6
2,500 to 4,999	19.1	0.4	2.1	18.4	0.4	2.2	36.1	0.6	1.7	34.9	0.1	0.3
Under 2,500	9.8	0.3	3.1	9.2	0.2	2.2	20.2	0.2	1.0	8.8	0.1	0.1
Overall Regional Rate	52.4	2.9	5.5	37.9	1.0	2.6	76.2	1.1	1.4	52.1	1.3	2.5

*Insufficient data

Note: The Midwest was formerly called the Northcentral

Source: Karter, M., & Molis, J. *U.S. Firefighter Injuries-2008*, NFPA Division of Fire Analysis and Research, October 2009

Table 3. Average Number of Fires, Fireground Injuries and Injury Rates, by Population of Community Protected, 2008

Population of Community Protected	Average Number of Fires	Average Number of Fireground Injuries	Number of Fireground Injuries Per 100 Fires	Number of Fireground Injuries Per 100 Firefighters
500,000 to 999,999	2,946.1	80.4	2.7	7.5
250,000 to 499,999	1,184.3	38.2	3.2	7.9
100,000 to 249,999	539.5	10.7	2.0	4.8
50,000 to 99,999	239.4	6.4	2.7	6.2
25,999 to 49,999	133.7	2.7	2.0	4.2
10,000 to 24,999	65.0	1.1	1.7	2.5
5,000 to 9,999	39.2	0.5	1.3	1.6
2,500 to 4,999	24.2	0.4	1.7	1.5
Under 2,500	11.5	0.2	1.7	0.9

Source: Karter, M., & Molis, J. *U.S. Firefighter Injuries-2008*, NFPA Division of Fire Analysis and Research, October 2009

PM7. Human Saves and Rescues - Fire Incident Calls

Measure	Discussion	NFIRS Variable
<p>% of fires in which a person or people were rescued from the building by firefighters</p> <p>Number of “saves” vs. number of casualties</p> <p>Rate of saves per incident involving at least one save</p>	<p>Measures of “saves” or rescues show what portion of the community’s fire incident calls required rescue. There is obvious risk to firefighters entering buildings to remove victims; this measure tries to identify that risk. It also helps to identify the demand on the department for this service. This measure can be a very small number compared to the total number of fires responded to and would be less reliable and a low indicator of performance in communities where there are few rescues made.</p>	<p>Search and rescue is captured in actions taken codes 20-29 in the basic module.</p> <p>The number of people rescued is not captured in NFIRS. However, departments can use the actions taken variable to identify the number of fire incidents in which rescue or removal was necessary, as an alternative.</p> <p>Remember to limit analysis to incident type 100-199 for fires. Stratify categories-structure fires, vehicle fires, outside and other fires.</p>

Defining “saves” and developing rigorous, consistent procedures to count different kinds of saves is the principal problem with using a measure of “saves.”

Shaenman, Hall, et. al suggest that saves should be reported in terms of danger the fire posed to the person saved and the degree of assistance needed. For example, a healthy person not near the fire needs a different degree of assistance than an unconscious victim in the area of fire origin.

Data on “saves” can be compared to data on injuries - to evaluate the effectiveness of fire rescue forces in rescue situations. “Saves” can also be added to data on injuries to identify the kinds of buildings in which people are repeatedly exposed to situations where rescue is needed (Schaenman, Hall, et. al).

PM8. Property Saves - Fire Incident Calls

Measure	Discussion	NFIRS Variable
<p>Total \$'s saved, in terms of structure and contents</p> <p>Average \$'s saved per fire</p> <p>% of fires in which \$ damage to the building was greater than "x" amount of dollars</p> <p>% of fires in which \$'s saved was greater than "x" amount of dollars</p>	<p>In order to be reliable and valid, buildings and dollars saved must be looked at realistically. For example, if the fire department is alerted to a confined cooking fire in a very large building with expensive contents, or an alarm activation with nothing found, it is not realistic to say that the firefighters saved millions of dollars worth of property from being destroyed. These measures can be determined by using dollar estimates collected in NFIRS, but remember to be realistic in estimates and discuss this issue when using these measures. Averages can be significantly raised by the inclusion of a single major loss.</p>	<p>Estimated dollar losses and values in the basic module of NFIRS can be used to calculate dollars saved.</p> <ol style="list-style-type: none"> Property saved (Pre-incident property value minus Property losses) Contents saved (Pre-incident content value minus Content losses) Total \$'s saved (Pre incident total dollar value minus Total dollar value) <p>Remember to limit analysis to incident type 100-129 for structure fires. Optional-remove confined fires 113-118 as "saves" in these fires may skew estimates. It is possible that property saves can be measured for non-structure fires.</p>

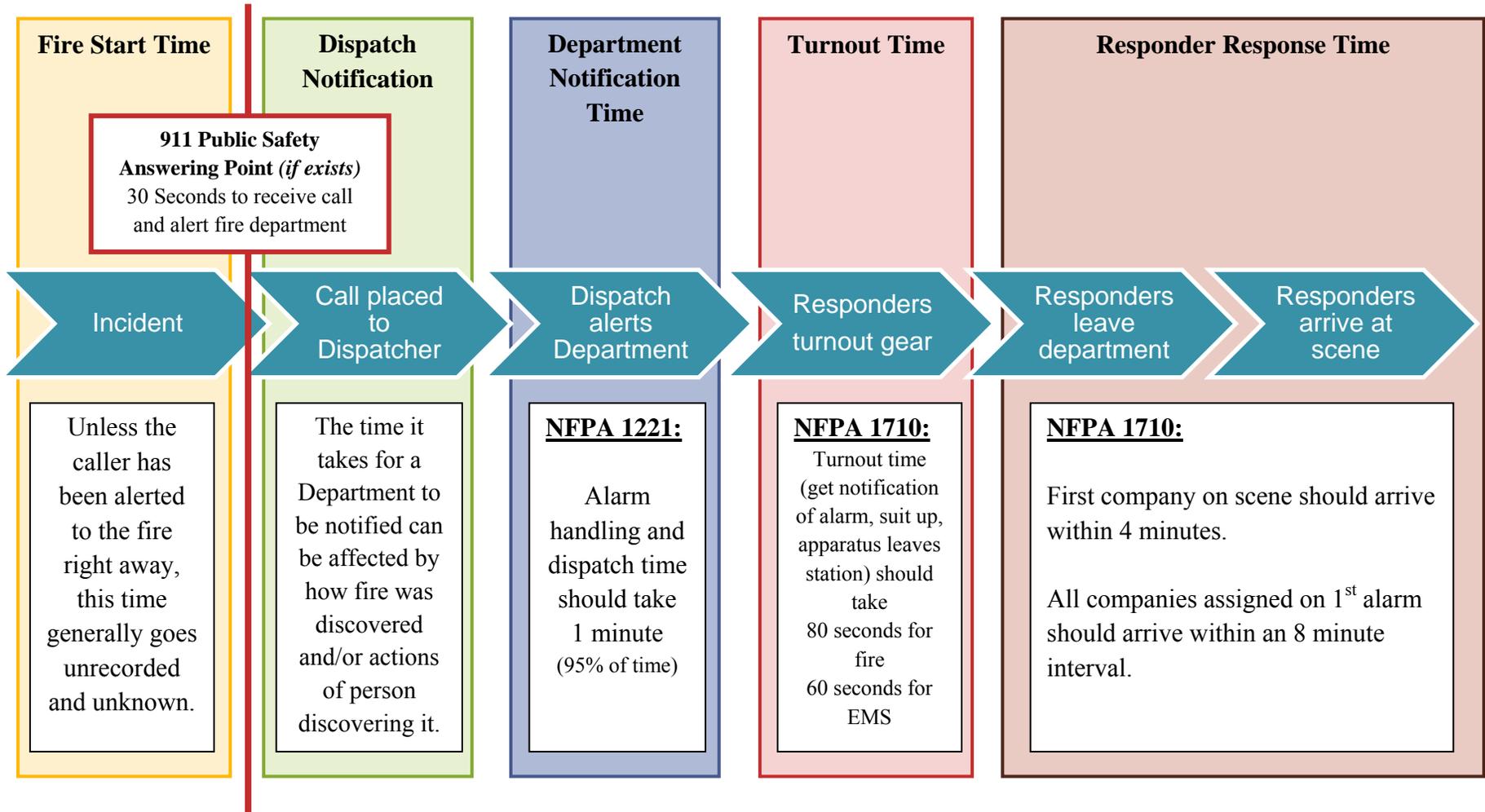
PM9. Quality of Service - Training and Certification - Fire Incident Calls

Measure	Discussion	NFPA Standard
<p>% of firefighters with completed, up-to-date training</p> <p>% of firefighters that are certified</p>	<p>This measure is a proxy for quality of service provided. It is assumed that a high percentage of responders with completed training and certification are providing high quality service when responding to calls. The measures should be stratified by response type and certification or training required by responder for that response.</p>	<p>NFPA 1001: Standard for Fire Fighter Professional Qualifications provides qualification guidelines for Fire Fighter I and Fire Fighter II.</p>

Requirements for training and certification are intended to keep responders up-to-date on techniques. It is assumed that a high percentage of responders with completed training and certification are providing high quality service when responding to calls.

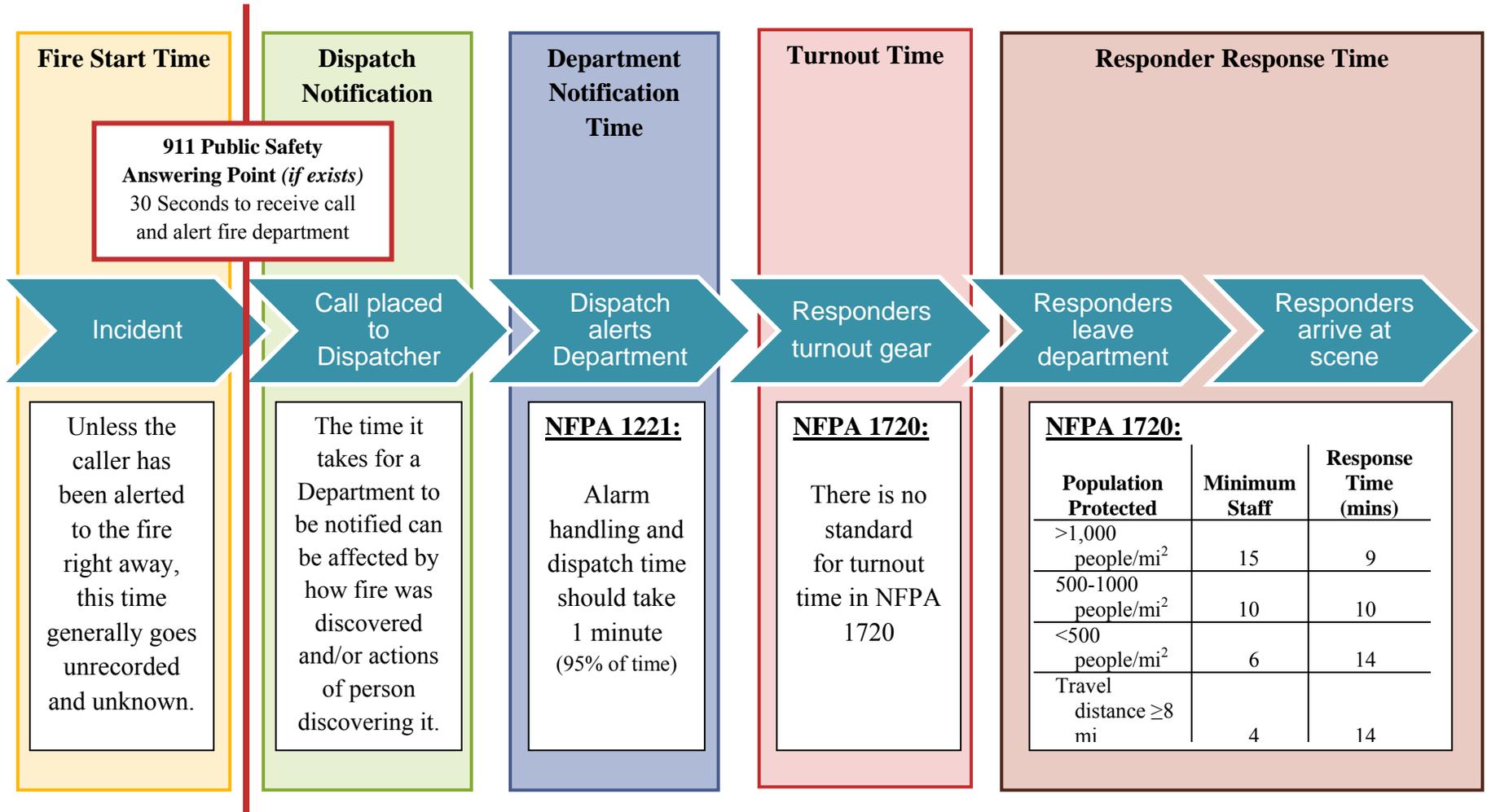
However, different departments require different levels of training and a department with 100% completed, up- to-date training may not be providing as high quality service if it has lesser requirements for training.

Figure 2. Incident Development and Response Timeline and NFPA 1221 and 1710 Recommendations for Career Firefighters



Source: NFPA 1221: Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems and 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.

Figure 3. Incident Development and Response Timeline and NFPA 1221 and 1720 Recommendations for Volunteer Firefighters



Source: NFPA 1221: *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems* and NFPA: 1720 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments*.

Medical Aid Responses

An estimated 43.8% of fire departments provide emergency medical service (EMS) (Karter & Stein). Some fire departments only provide initial aid to patients on scene until an ambulance from a private company or other agency arrives to transport the patient. Other departments transport patients to the hospital, and provide aid during transport. EMS services provide basic life support (BLS) or advanced life support (ALS) during transport.

PM10. Medical Response Rate

Measures	Discussion	NFIRS Variable
# EMS calls/1,000 population # fire calls requiring EMS/1,000 population # fire calls requiring EMS/1,000 fires	This measure can be used as an aggregate for the demand for EMS service within the community and it can be broken down further to see what portion of EMS rescues result from fire incidents.	Rescue and emergency medical service incidents are captured by incident type code 300-399 in the basic module. Emergency medical service incidents are specifically incident type codes 320-329

For their own purposes, a fire department may also wish to distinguish between the age of the patient or the occupancy/nature of injury where EMS was required. What portion of EMS calls were due to traffic-related injuries? How many injuries occurred in private residences versus businesses or housing for older adults? Performance and resources can be significantly impacted by the existence of certain occupancy types. For example the proposal to build a large assisted living facility may impact expected performance when construction is underway and complete. These measures may be useful for future planning.

PM11. Response and Transport Times - Emergency Medical Response Calls

Measures	NFPA Standard	NFIRS Variable
<p>Time should be stratified into:</p> <ol style="list-style-type: none"> 1. Turnout time 2. Travel time 3. Total response time 4. Transport time 5. Hospital offload time 6. Total call time (time from arrival to end of hospital offload) <p>Average response times per incident call</p> <p>% of times that are less than “x” minutes</p> <p>% of times that are more than times less than “x” minutes</p>	<p>NFPA 1710 recommends a turnout time of 60 seconds for EMS incidents.</p> <p>NFPA 1710 says that “the fire department’s EMS for providing a first responder with automated external defibrillator (AED) shall be deployed to provide for the arrival of a first responder with AED company within a 240-second travel time to 90% of the incidents.”</p> <p>When provided, the fire department’s EMS for providing advanced life safety (ALS) shall be deployed to provide for the arrival of an ALS company within a 480-second travel time to 90% of the incidents provided a first responder with AED or basic life safety (BLS) unit arrived in 240 seconds or less travel time</p> <p>There are no response requirements in NFPA 1720 for EMS response.</p>	<p>NFIRS dates and times are numerically entered values in the basic module.</p> <p><u>Variables include:</u> Alarm time Arrival time Controlled time Last unit cleared</p> <p><u>These can be used to calculate:</u></p> <ol style="list-style-type: none"> 1. Total response time (Arrival-Alarm time) 2. Time to control the fire (Controlled time-Arrival time) 3. Time spent on scene (Last unit cleared-Arrival time) <p>Remember to specify incident type 300-399. Stratify incident type by general category.</p> <p>Time arrived at patient and time of patient transfer is captured in the EMS module.</p> <p>These can be used to calculate:</p> <ol style="list-style-type: none"> 1. Response time, arrival at patient (Arrival at patient-Alarm time)

It is important to clearly define arrival time when using this measure. The department usually calculates response time by using the time of arrival to scene, which may not mean arrival to patient. Take this into consideration when comparing performance to other departments.

Shorter response times can be expected in urban areas compared to rural areas, due to size, the number of facilities, such as fire stations, within the community. This needs to be taken into consideration when comparing response time performance across communities.

PM12. Patient Treatment Measures

Measures	Discussion	NFIRS Variable
<p>% of patients that required BLS</p> <p>% of patients that required ALS</p> <p>% of patients that refused treatment</p> <p>% of patients transported from scene in fire service ambulance or apparatus</p> <p>% of patients that were treated on scene</p>	<p>These measures identify the demand for EMS services based on patient data. A more detailed measure would examine the % of patients requiring transport to hospital by symptom of patient or cause of injury.</p> <p>Time it takes to transport patients can be a contributing factor in the level of treatment needed or the status of the patient. Analyzing patient treatment measures along with transport time paints a clearer picture of performance.</p>	<p>EMS and transport is captured in actions taken codes 30-39 in the basic module.</p> <p>The number of people needing EMS or transport is not captured on the basic module NFIRS. However, departments can use incident totals, as an alternative to people.</p> <p>Remember to limit analysis to incident type 300-399 for EMS incidents.</p> <p>The EMS module in NFIRS captures patient status-improved, remained same, worsened. This variable can be used in concert with measures of patients treated on scene and level of treatment required.</p>

PM13. Quality of Service - Training and Certification - Emergency Medical Response Calls

Measure	Discussion	NFPA Standard	NFIRS Variable
<p>% of EMS personnel with completed, up-to-date training</p> <p>% of EMS personnel that are certified</p>	<p>This measure is a proxy for quality of service provided. It is assumed that a high percentage of responders with completed training and certification are providing high quality service when responding to calls. The measures should be stratified by response type and certification or training required by responder for that response.</p>	<p>NFPA 1710: recommends that the minimal level of training for all firefighters that respond to emergency incidents shall be to the first responder/automated external defibrillator (AED) level. The authority having jurisdiction (AHJ) determines further training requirements.</p>	<p>Training and certification is not captured in NFIRS. However, there are two variables in the EMS module: initial level of provider and highest level of care provided on scene.</p> <p>The % of incidents handled by the various levels of care can be analyzed along with completed training and certification.</p>

Every state requires that EMT’s and paramedics be certified and keep certification updated. Requirements for training and certification are intended to keep EMS personnel up-to-date on

medical response techniques. It is assumed that a high percentage of EMS personnel with completed training and certification are providing high quality service when responding to calls. Departments may wish to make a distinction between first responder, basic life support (BLS), advanced life support (ALS) and paramedic.

Tables 3 and 4 have been taken from the report, *Four Years Later-A Second Needs Assessment of the U.S. Fire Service*, which was published by NFPA and the U.S. Fire Administration. These tables show the percentage of personnel that perform EMS functions and the certification level attained by EMS personnel by population protected.

Table 4. Personnel Who Perform EMS for Departments that Provide Emergency Medical Service, by Community Size

Population of Community	All		Most		Some		None		Total	
	Number of Departments	Percent								
1,000,000 or more	15	(0%)	0	(0%)	0	(0%)	0	(0.0%)	15	(100%)
500,000 to 999,999	38	(10%)	0	(0%)	0	(0%)	0	(0.0%)	38	(100%)
250,000 to 499,999	52	(96%)	1	(2%)	1	(2%)	0	(0.0%)	54	(100%)
100,000 to 249,999	191	(90%)	17	(8%)	4	(2%)	0	(0.0%)	212	(100%)
50,000 to 99,999	367	(87%)	50	(12%)	4	(1%)	0	(0.0%)	421	(100%)
25,000 to 49,999	759	(81%)	151	(16%)	22	(2%)	0	(0.0%)	932	(100%)
10,000 to 24,999	1,628	(70%)	493	(21%)	210	(9%)	0	(0.0%)	2,331	(100%)
5,000 to 9,999	1,400	(51%)	838	(31%)	482	(18%)	4	(0.2%)	2,724	(100%)
2,500 to 4,999	1,397	(43%)	979	(30%)	878	(27%)	0	(0.0%)	3,254	(100%)
Under 2,500	2,651	(32%)	2,404	(29%)	3,132	(38%)	29	(0.4%)	8,215	(100%)
Total	8,498	(47%)	4,932	(27%)	4,734	(26%)	33	(0.2%)	18,199	(100%)

Source: FEMA US Fire Administration 2005
Survey of the Needs of the US Fire Service

The above projections are based on 3,431 departments reporting yes to Question 14a and also reporting on this question. Numbers may not add to totals due to rounding.

Q. 14b: If [emergency medical service is a role your department performs], how many of your personnel who perform this duty have received formal training (not just on-the-job)?

Table 5. For Departments that Provide Emergency Medical Service Level that Personnel Have Been Certified To, by Community Size

Population of Community	None	First Responder	Basic Life Support	First Responder Basic Life Support	First Responder Basic Life Support Advanced Life Support	Basic Life Support Advanced Life Support Paramedic	First Responder Advanced Life Support Paramedic	Advanced Life Support Paramedic	Total
1,000,000 or more	(0%)	(10%)	(0%)	(0%)	(50%)	(40%)	(0%)	(0%)	(100%)
500,000 to 999,999	(0%)	(0%)	(4%)	(8%)	(58%)	(23%)	(0%)	(8%)	(100%)
250,000 to 499,999	(0%)	(9%)	(4%)	(4%)	(35%)	(41%)	(0%)	(7%)	(100%)
100,000 to 249,999	(2%)	(4%)	(9%)	(10%)	(29%)	(39%)	(1%)	(7%)	(100%)
50,000 to 99,999	(40%)	(3%)	(9%)	(10%)	(32%)	(38%)	(1%)	(7%)	(100%)
25,000 to 49,999	(80%)	(3%)	(10%)	(10%)	(29%)	(35%)	(2%)	(10%)	(100%)
10,000 to 24,999	(60%)	(5%)	(11%)	(16%)	(32%)	(29%)	(1%)	(6%)	(100%)
5,000 to 9,999	(1%)	(6%)	(13%)	(25%)	(29%)	(20%)	(1%)	(4%)	(100%)
2,500 to 4,999	(2%)	(11%)	(12%)	(25%)	(32%)	(15%)	(3%)	(2%)	(100%)
Under 2,500	(3%)	(17%)	(12%)	(36%)	(19%)	(8%)	(3%)	(2%)	(100%)
Total	(2%)	(11%)	(10%)	(26%)	(22%)	(13%)	(2%)	(3%)	(100%)

Source: FEMA U.S. Fire Administration 2005
Survey of the Needs of the U.S. Fire Service

The above projections are based on 3,464 departments reporting yes to Question 14a, and also reporting on this question. Numbers may not add to totals due to rounding.

Q. 14c: If [emergency medical service is a role your department performs], have any of your personnel been certified to any of the following levels?

A hazardous material is any material that is an air-reactive material, flammable or combustible liquid, flammable gas, corrosive material, explosive material, organic peroxide, oxidizing material, radioactive material, toxic material, unstable material, or water-reactive material; and any substance or mixture of substances that is an irritant or a strong sensitizer or that generates pressure through exposure to heat, decomposition, or other means (NFIRS).

PM14. Rate of HazMat Calls

Measures	NFIRS Variable
<p># HazMat calls/1,000 population</p> <p># HazMat calls/1,000 buildings (by occupancy or property use*)</p> <p>*Many hazmat calls are related to vehicles. The department may want to include hazmat calls by property use: “outside and other”</p>	<p>Hazardous condition responses by fire departments are captured in NFIRS basic module as incident type 400-499. Incident type 400-439 capture incidents involving hazardous materials, and 440-499 and 400 capture other hazardous conditions.</p> <p>Departments should use totals and stratify incident rates by category. The department can also stratify hazmat call rates by physical state of hazard when it was released (solid, liquid, gas, or undetermined).</p>

Measures of rates of hazmat calls are measures of department workload and demand for a specific function. These measures represent the flow of calls or incidents that need to be served by the fire service, related to hazardous materials. Fire rates are analyzed over time to see that inspections programs are reducing fires within the community, fire rates are also impacted by education programs. Hazardous material rates can also be examined over time for the same reasons. Lower rates may be a sign of increased education, awareness, safety precautions in handling and storing hazardous materials.

The fire department cannot directly measure their performance just by analyzing the hazardous material rate. Performance is the action taken to mitigate the hazard and protect the public. By examining hazmat call rates along with measures of response time, control time, size of contamination, and cleanup, the fire department can start to analyze their performance in hazmat incident response.

PM15. Response and Transport Times - HazMat Calls

Measures	Discussion	NFPA Standard	NFIRS Variable
<p>Times should be stratified into:</p> <ol style="list-style-type: none"> 1. Turnout time 2. Travel time 3. Total response time 4. Control time 5. Time spent on scene <p>Average response time per hazmat incident call</p> <p>% of times that are less than "x" minutes</p> <p>% of times that are more than "x" minutes</p> <p>Average time to control incident, by size on arrival and type of occupancy</p>	<p>Shorter response times can be expected in urban areas compared to rural areas, because of the number of facilities, such as fire stations, within the community. Rural areas have less access to facilities. This needs to be taken into consideration when comparing response time performance across communities.</p>	<p>NFPA 1710 recommends a turnout time 80 seconds for special operations response.</p> <p>There are no response requirements in NFPA 1720 for special operations response.</p>	<p>NFIRS dates and times are numerically entered values in the basic module.</p> <p><u>Variables include:</u> Alarm time Arrival time Controlled time Last unit cleared</p> <p><u>These can be used to calculate:</u></p> <ol style="list-style-type: none"> 4. Total response time (Arrival-Alarm time) 5. Time to control the fire (Controlled time-Arrival time) 6. Time spent on scene (Last unit cleared-Arrival time) <p>Remember to specify incident type 400-499. Stratify incident type by general category.</p>

PM16. Hazard Spread and Size

Measure	Discussion	NFIRS Variables
<p>% of all hazmat incidents in which hazard continued to spread before department arrival</p> <p>% of total hazmat incidents responded to that spread beyond area of origin after fire department arrival</p> <p>% of hazmat incidents that did not spread beyond the area of origin after firefighters arrived on scene</p> <p>Average size of contaminated area</p> <p>% of hazmat call in which contaminated area was larger than “x” square feet (for liquids) or miles (for gases or airborne hazardous materials)</p>	<p>These measures identify the actual success made in mitigating the hazard. By removing hazardous material incidents that were mitigated or controlled before arrival, the fire department is able to actually measure the effect of their actions taken toward controlling the spread of hazardous material.</p> <p>In some cases the fire department controls the situation but outside contractors clean up the hazard.</p>	<p>In the NFIRS HazMat Module, there is a variable for area affected. The unit of measure for area is in square feet, blocks, or square miles, adapt the last measures in the table to match the units you are interested in examining.</p> <p>Unfortunately, this variable only captures total area affected, not area affected before arrival or after arrival of firefighters. The fire department will have to record size of affected area upon arrival on their own.</p> <p>There is also a variable in the HazMat Module which captures the estimated amount released by volume or weight. This variable can be used in measures similar to hazard spread. Again this is an estimate of total amount released, not the amount released before firefighter arrival. The fire department will have to record the amount of hazard released upon arrival on their own.</p>

PM18. Quality of Service - Training and Certification - HazMat Calls

Measure	Discussion	NFPA Standard
<p>% of responders with completed, up-to-date training</p> <p>% of responders that are fully certified</p>	<p>This measure is a proxy for quality of service provided. It is assumed that a high percentage of responders with completed training and certification are providing high quality service when responding to calls. The measures should be stratified by response type and certification or training required by responder for that response.</p>	<p>NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents identifies the minimum levels of competence required by responders to emergencies involving hazardous materials/weapons of mass destruction (WMD).</p> <p>NFPA 473: Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents identifies the levels of competence required of emergency medical services (EMS) personnel who respond to incidents involving hazardous materials or weapons of mass destruction (WMD). It specifically covers the requirements for basic life support and advanced life support personnel in the pre-hospital setting.</p>

Requirements for training and certification are intended to keep responders up-to-date on techniques. It is assumed that a high percentage of responders with completed training and certification are providing high quality service when responding to calls.

However, different departments require different levels of training and a department with 100% completed, up- to-date training may not be providing as high quality service if it has lesser requirements for training.

Other Calls

There is little to no research available on fire department performance measures associated with “other calls” that are made to fire departments. False alarm and nuisance alarm responses are included in this section.

PM19. Rate of Nonfire, Nonmedical Emergency, and Nonhazardous Materials Calls

Measures	NFIRS Variable
# other calls/1,000 population # other calls/1,000 buildings (by occupancy)	<p>All other calls-calls not including fire incidence, EMS, or HazMat response, to fire departments are captured in NFIRS basic module as incident type:</p> <ul style="list-style-type: none"> 200-299 Overpressure Rupture, Explosion, Overheat (No Fire) 500- 599 Service Calls 600-699 Good Intent Calls 700-799 False Alarms 800-899 Severe Weather and Natural Disaster 900-999 Special Incident Type <p>Departments should use totals and stratify fire rates by category.</p>

Measures of rates of “other” calls are measures of department workload and demand for a specific function. These measures represent the flow of calls or incidents that need to be served by the fire service, related to “other,” non-fire, non-EMS, and non-hazmat incidents. Fire rates are analyzed over time to see that inspections and education programs are reducing fires within the community. “Other” call rates can also be examined over time for the same reasons. Lower rates may be a sign of increased education. For example, a successful public education program that teaches individuals how to identify an emergency and alert the fire department should result in fewer false alarm calls.

The fire department cannot directly measure their performance just by analyzing the “other” calls rate. Performance is the action taken to address the call and protect the public. By examining “other” call rates along with measures of response time and time spent on scene, by incident type, the fire department can start to analyze their performance in “other” incident response.

PM20. Response Times - Other Calls

Measures	Discussion	NFPA Standard	NFIRS Variable
<p>Times should be stratified into:</p> <ol style="list-style-type: none"> 1. Turnout time 2. Travel time 3. Total response time 4. Time spent on scene <p>Average response time per "other call"</p> <p>% of times that are less than "x" minutes</p> <p>% of times that are more than "x" minutes</p>	<p>Shorter response times can be expected in urban areas compared to rural areas, because of the number of facilities, such as fire stations, within the community. Rural areas have less access to facilities. This needs to be taken into consideration when comparing response time performance across communities.</p>	<p>NFPA 1710 recommends a turnout time 80 seconds for special operations response.</p> <p>There is no response requirement in NFPA 1720 regarding special operations.</p>	<p>NFIRS dates and times are numerically entered values in the basic module.</p> <p><u>Variables include:</u> Alarm time Arrival time Last unit cleared</p> <p><u>These can be used to calculate:</u></p> <ol style="list-style-type: none"> 1. Total response time (Arrival minus Alarm time) 2. Time to control the fire (Controlled time minus Arrival time) 3. Time spent on scene (Last unit cleared minus Arrival time) <p>Remember to specify incident types: 200-299 Overpressure Rupture, Explosion, Overheat (No Fire) 500- 599 Service Calls 600-699 Good Intent Calls 700-799 False Alarms 800-899 Severe Weather and Natural Disaster 900-999 Special Incident Type</p>

Other Fire Department Activities

Fire departments are not only responsible for the four major response functions discussed in this report. Departments are also responsible for **fire code compliance inspections, plans review, fire and life safety education programs, and fire investigations**. Vision 20/20: National Strategies for Fire Loss Prevention suggests potential measures for each of these areas in the report, *Model Performance Measures for Fire Prevention Programs*.

Code Compliance Effectiveness Measures

The National Fire Protection Association and Fire Protection Research Foundation published a report in July 2008 that identified eleven core measures for evaluating the effectiveness of fire inspection programs. The full report is available at www.nfpa.org/foundation under miscellaneous reports.

Table 6 is an excerpt from the article *Measuring-up*, published in the January/February 2009 edition of NFPA Journal.

PM21. Eleven Core Measures of Code Compliance Effectiveness

Core Measures	Formula
1. Structure fire rate	$\text{Structure fires in inspectable properties} \div 1,000 \text{ inspectable properties}$
2. Presence and severity of hazard matrix	List each fire \geq \$25k and list (1) each hazard present (2) the magnitude of the contribution of the hazard to the fire's severity
3. Value per additional inspection	$(\text{Fire loss per year}) \times (\text{the percentage of loss that was preventable by inspection}) \div (\text{the number of occupancies})$
4. Number of violations	List the number of violations per inspection for (1) Every inspection (2) Sprinkler-related violations (3) Safe-evacuation-related violations
5. Percent of preventable fires	$(\text{The number of preventable fires} \div \text{the total number of fires}) \times 100$
6. Percent of fires with pending, uncorrected violations at time of fire	$(\text{The number of fires with pending or uncorrected violations at time of fire} \div \text{the total number of fires}) \times 100$
7. Percent of properties not inspected	$(\text{The number of fires in properties subject to inspection not listed in files} \div \text{the total number of fires}) \times 100$
8. Percent of inspections not completed in target cycle	$(\text{The number of inspections for which time since last inspection was greater than department's target cycle} \div \text{the total number of inspections performed}) \times 100$
9. Building systems/features without completed inspection	List the major building systems and features, for which inspection and approval were not completed, per new construction project. Record the number and/or fraction of new construction cases where inspection and approval were not completed for that particular system or feature.
10. Percent certified inspections	$(\text{The number of inspections conducted by inspectors with all necessary certifications} \div \text{the total number of inspections performed}) \times 100$
11. Percent of full-time inspector inspections	$(\text{The number of inspections conducted by full-time inspectors} \div \text{the total number of inspections}) \times 100$

Conclusion

Performance measurement relies on the evaluation of achieved outcomes, compared to desired outcomes. Clearly identifying the goals and purpose of the department and fire service functions is the first step to evaluating performance. The easiest and best way of measuring the achievement of goal statements is to specifically identify target rates or percentages for each goal. Individual measures have varying degrees of appropriateness and strength when evaluating overall performance of the department and fire service functions.

Current performance should be compared to past performance and to target goals. This may mean evaluating performance seasonally, quarterly, or annually. The adequacy of local operations can be assessed by comparing performance to a standard performance level or benchmark. Benchmarks vary and can be based on technical standards, historical data, comparables from similar departments, or specific organizational priorities. Assumptions must be made in using benchmarks and it is critical that these assumptions and their limitations be identified so they can be researched and improved upon.

In the end, a fire department can be very efficient at performing the necessary procedures to achieve the desired outcome, but not be very effective in achieving the desired goal or outcome. The converse is also true. This needs to be remembered when evaluating the effectiveness and efficiency of the department.

This report introduced the concept and fundamentals behind performance measurement. One potential “next step” is to identify the key outcomes or desired goals as they relate to the fire service. From here, the fire service can identify the universally accepted procedures that achieve that outcome. After these key activities or procedures are identified they can be measured and linked to the outcome directly. And, from here performance measures can be tailored to specific activities and be more telling of the effectiveness of efficient fire department practices.

References

- Ahrens, M., *Smoke Alarms in U.S. Home Fires*, NFPA Division of Fire Analysis and Research, July 2009.
- Ammons, D., *Municipal Benchmarks: Assessing Local Performance and Establishing Community Standards*, Sage Publications, Second Edition, 2001.
- Behn, R., "Why Measure Performance? Different Purposes Require Different Measures," *Public Administration Review*, Vol. 63 No. 5, September/October 2003.
- Chaiken, W., Ignall, E., *Fire Department Deployment Analysis: A Public Policy Analysis Case Stud*, *The Rand Fire Project*, A Rand Corporation Research Study, 1979.
- Cline, D., *Organizational Benchmarking and Performance Evaluation*, NFPA Fire Protection Handbook, 20th edition, Volume II, Chapter 12.2, 2008.
- Folz, D., *Service Quality and Benchmarking the Performance of Municipal Services*, Public Administration Review, 2004.
- Hall, J.R. Jr., Flynn, J., Grant, C. *Measuring Code Compliance Effectiveness for Fire-Related Portions of Codes*, the National Fire Protection Association and Fire Protection Research Foundation, 2008.
- Hall, J.R. & Karter, M., *A Second Needs Assessment of the U.S. Fire Service*, U.S. Fire Administration and NFPA, October 2006.
- Hatry, H., Fisk, D., Hall, J.R. Jr., Schaenman, P., Snyder, L., *How Effective Are Your Community Services? Procedures for Performance Measurement*, ICMA, Third Edition, 2006.
- Karter, M., *Fire Loss in the United States 2008*, NFPA Division of Research and Analysis, September 2009.
- Karter, M., & Stein, G., *U.S. Fire Department Profile Through 2007*, NFPA Division of Fire Analysis and Research, November 2008.
- Karter, M., & Molis, J. *U.S. Firefighter Injuries-2008*, NFPA Division of Fire Analysis and Research, October 2009.

Proulx, G., "Response to Fire Alarms" *Fire Protection Engineering*, Winter 2007, pp. 8-15.
Online at http://www.fpemag.com/archives/article.asp?issue_id=40&i=267.

Schaenman, P. & Swartz, J., *Measuring Fire Protection Productivity in Local Government*, The Urban Institute and NFPA, 1974.

Schaenman, P., Hall, J.R., Schainblatt, A., Swartz, J., & Karter, M., *Procedures for Improving the Measurement of Local Fire Protection Effectiveness*, The Urban Institute and NFPA, 1976.

Vision 20/20 National Strategies for Fire Loss Prevention, *Model Performance Measures for Fire Prevention Programs*, March 2009.

U.S. Fire Administration and National Fire Data Center, *National Fire Incident Reporting System 5.0 (NFIRS): Complete Reference Guide*, January 2004

U.S. Fire Administration and National Fire Data Center, "Structure Fire Response Times," *Topical Fire Research Series, Volume 5-Issue 7*, Department of Homeland Security, January 2006/Revised August 2006 <http://www.usfa.dhs.gov/downloads/pdf/tfrs/v5i7.pdf>.