Fire Operations Assessment and Data Analysis

City of Ann Arbor, Michigan

December 2011

FIRE OPERATIONS  FIRE OPERATIONS

I C M A C O N S U L T I N G S E R V I C E S

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ICMA

Leaders at the Core of Better Communities

General Information

ICMA Background

The International City/County Management Association (ICMA) is the premier local government leadership and management organization. Since 1914, ICMA's mission has been to create excellence in local governance by developing and advocating professional local government management worldwide. ICMA provides an information clearinghouse, technical assistance, training, and professional development to more than 9,000 city, town, and county experts and other individuals throughout the world.

ICMA Consulting Services

The ICMA Consulting Services team helps communities solve critical problems by providing management consulting support to local governments. One of ICMA Consulting Services' areas of expertise is public safety services, which encompasses the following areas and beyond: organizational development, leadership and ethics, training, assessment of calls-for-service workload, staffing requirements analysis, design of standards and hiring guidelines for police and fire chief recruitment, police/fire consolidation, community-oriented policing, and city/county/regional mergers.

Performance Measures

The reports generated by the operations and data analysis team are based upon key performance indicators that have been identified in standards and safety regulations and by special interest groups such as the International Association of Fire Chiefs, International Association of Fire Fighters, Association of Public Safety Communication Officials International, and through the Center for Performance Measurement of ICMA. These performance measures have developed following decades of research and are applicable in all communities. For that reason, comparison of reports will yield similar reporting formats but each community's data are analyzed on an individual basis by the ICMA specialists and uniquely represent the compiled information for that community.

Methodology

The ICMA *Center for Public Safety Management* team follows a standardized approach to conducting analyses of fire, police, and other departments involved in providing safety services to the public. We have developed this standardized approach by combining the experience sets of dozens of subject matter experts who provide critical roles in data and operations assessments in the areas of police, fire, and EMS. Our collective team has more than a combined 100 years of conducting such studies for cities in the United States and internationally.

We begin most projects by extracting calls for service and raw data from an agency's computer aided dispatch system. The data are sorted and analyzed for comparison to nationally developed performance indicators. These performance indicators (response times, workload by time, multiple unit dispatching) are valuable measures of agency performance regardless of departmental size. The findings are shown in tabular as well as graphic form and are organized in a logistical format. While most of our documents' structure as well as the categories for performance indicators are standard, the data reported are unique to the cities. Due to the size and complexity of the documents, this method of structuring the findings allows for simple, clean reporting.

We then conduct an operational review alongside the data analysis. Here the performance indicators serve as the basis for those operational reviews. Therefore, and in addition to the standardized reporting process, the review process follows a standardized approach comparable to that of national accreditation agencies. Prior to any on-site arrival of an ICMA *Public Safety Management team*, we ask agencies to compile a number of key operational documents (e.g., policies and procedures, assets lists, etc.). Most on-site reviews consist of interviews with management and supervisors as well as rank-and-file officers; we also interview city staff.

As a result of any on-site visits and data assessments, our subject matter experts produce observations and recommendations that highlight strengths, weaknesses, opportunities, and threats of all areas under review, including, fire personnel, interviews, research, relevant literature, statutes, regulations, comparative evaluation of fire service industry standards, meetings, and other areas specifically included in a project's scope of work.

We have found that this standardized approach ensures that we measure and observe all of the critical components of a fire agency, which in turn provides substance to benchmark statistics for cities with similar profiles. We are able to do this because we recognize that while agencies may vary in size and challenges, there are basic commonalities and best practices in use throughout the country.

We liken this standardized approach to the manner of the scientific method: we ask questions and request documentation upon project startup; confirm accuracy of information received; deploy operations and data analysis teams on site to research the uniqueness of each environment; perform data modeling and share preliminary findings with each city; assess any inconsistencies reported by client cities; and finally, communicate our results in a formal, written report, and occasionally through an in-person presentation by the project team and other key contributors.

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I. Executive Summary

This report provides a benchmark for the Ann Arbor Fire Department in its delivery of fire and EMS services. For definition purposes, a benchmark is the existing performance for an agency. The benchmark performance information can be found in Section III.

In addition to examining the benchmark performance being provided by the department, this study also looked at the department's existing operational performance and makes recommendations at ways to improve. Fire and EMS departments tend to deploy resources utilizing traditional approaches that are rarely reviewed. This report seeks to identify ways the department can improve efficiency, effectiveness, and safety for both its members as well as the community it serves. The recommendations may be adopted in whole, in part, or rejected. However, ICMA recommends that, for any implementation, specific objectives be assigned to individuals with a reporting/report card process to deliver input to the city administration and elected officials.

Our recommendations, based on best practices and the knowledge of ICMA reviewers, include:

Governance and Administration

1. Reassign dispatch liaison responsibilities from the Assistant Fire Chief for Administration to each on-duty battalion chief. Remove functional area titles to functional table of organization.

2. Develop separate functional and position/billet organization charts.

Assessment and Planning

3. Conduct a community risk analysis using the Vision™ risk assessment software or other similar product to classify individual properties within the community.

4. Adopt a strategic goal of achieving fire department accreditation within a specific time period.

5. Revise the strategic plan to develop measurable and time-bound goals and objectives based on use of current environmental scan and SWOT analysis.

6. Develop department business and action plan for monitoring performance.

7. Develop a fire protection master plan for the City of Ann Arbor and which is approved by city elected officials.

Financial Performance

8. Consider reopening the collective bargaining agreement with Local 693 to renegotiate articles concerning food allowances, tuition reimbursement, and health insurance coverage.

Programs

Fire Suppression

9. Consider including CAFS in all new fire suppression vehicle specifications and retrofitting specific frontline fire vehicles based on community risk assessment and historical call review.

10. Consider purchase of fire interruption tools for placement on all fire suppression, rescue, and command vehicles.

11. Consider acquisition of medium-size pumper for operations deployment within fire districts based on historical fire call requirements and projected community growth trends.
12. Consider reopening of labor agreement to negotiate deployment of QRV with reduced staffing of one less firefighter at station 3.
13. Investigate cause of false alarms and employ appropriate method(s) to reduce total responses.
14. Consider replacing R1-1 suppression type vehicle with a QRV and reduce staffing to two firefighters.
15. Conduct critical tasks analysis using an historical review of specific fire response data and consideration of likely community changes to determine effective/efficient crew size.
16. Consider deploying peak load staffing unit with quick response vehicle with two firefighters.
17. Consider tracking access time and setup time as part of total fire department reflex time.
18. Consider upgrading station notification systems and monitor crew turnout performance.
19. Develop response time standards for the community based on selected methodology(ies) approved by city elected officials.

Fire Prevention and Public Education

20. Consider hiring civilian employees for fire inspector and public education specialist positions.
21. Develop a comprehensive smoke detector program with an emphasis on residential structures.

22. Consider acquisition and placement of automated external defibrillators (AEDs) on all police vehicles. Develop a comprehensive citywide public access defibrillation (PAD) program, partnering with city parks and other departments to improve cardiac arrest outcomes.

Training

23. Develop packaged lesson plans or “canned training modules” with a comprehensive training schedule for department personnel using line officers as points of delivery.

Communications

24. Develop performance measures for Huron Valley Ambulance (HVA) contract language.

25. Consider establishment of an advisory committee comprised of representatives of area fire departments to serve in an ad hoc capacity to monitor HVA system performance and offer recommendations for improvement.

II. Operational Analysis

A. Governance and Administration

The City of Ann Arbor Fire Department is headed by a fire chief who reports to the safety services area administrator. The department has experienced a few changes in leadership over the last few years; it has also been involved in the process of the city adopting a public safety administrative consolidation model. Legal authority for the Ann Arbor Fire Department is granted through Ann Arbor, Michigan, Code of Ordinances, Title 1 Administration, Chapter 4 – Duties of Administrative Officers and Services Areas. Ordinance number 5- 97, § 1, 3-3-97 was amended by ordinance number 43-04, § 3, adopted January 3, 2005 to read as the aforementioned. Section 5.9 of the Ann Arbor City Charter establishes the fire department under the immediate charge of the fire chief and identifies specific responsibilities for the fire chief in connection with the use, care, and management of the city's firefighting apparatus and property, as well as conducting supervisory and education programs for the purpose of reducing the risk of fire within the city.

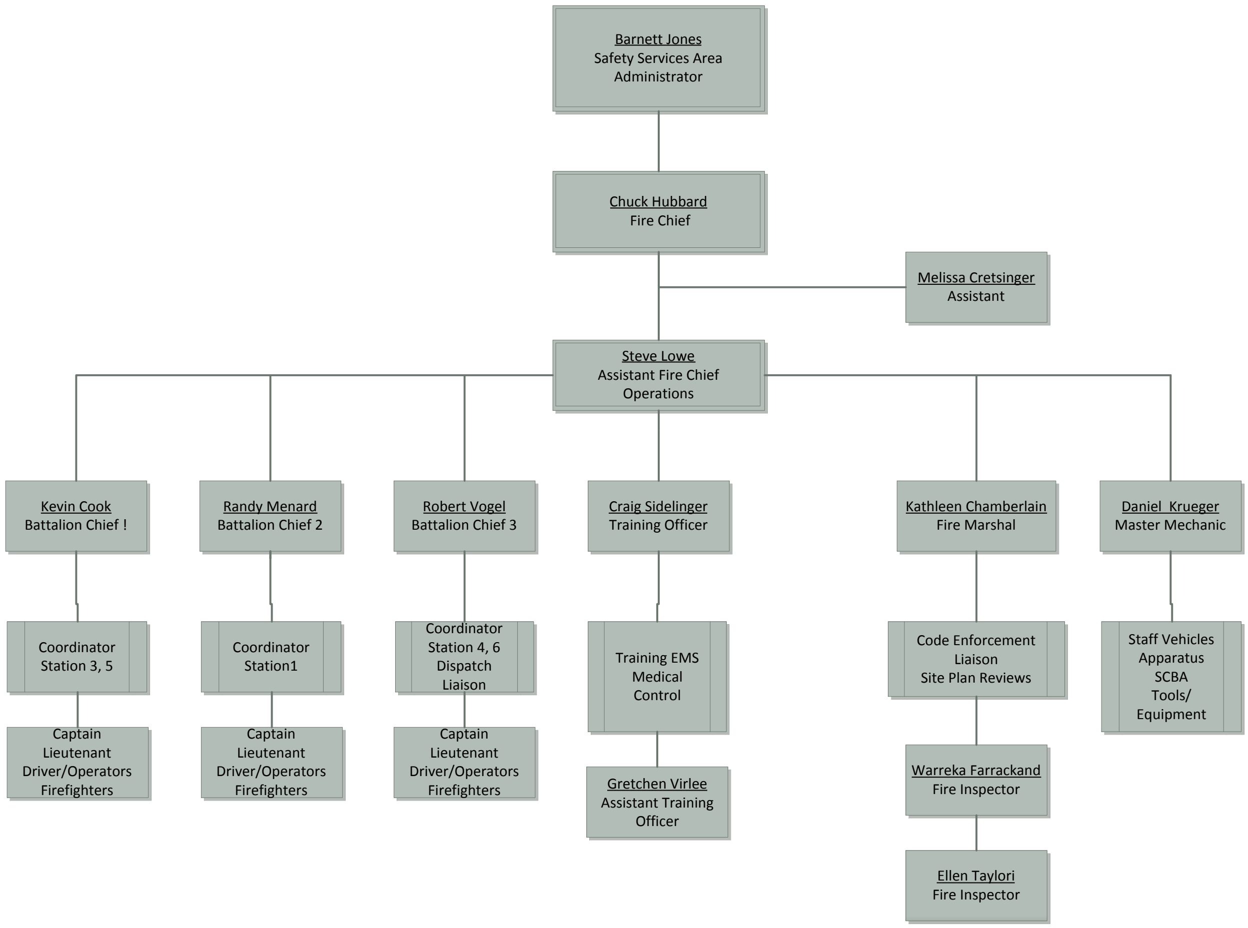
Under section 5.1 of the city charter it is the duty of the city administrator to direct, supervise, and coordinate the work of the fire department. The council-approved administrative organization plan of the city authorizes the delegation of that responsibility to the safety services area administrator, who's general responsibilities are established in Section 1:103 of the Ann Arbor City Code. The safety services area administrator is appointed by the city administrator with the advice and consent of the city council.

Various other provisions of the city code require administrative actions by the fire chief or the fire department; however, the provision for the prevention of fires and the protection of persons and property from the exposure to the dangers of fire and explosion are specifically adopted in the city code as Chapter 111.

The safety services area administrator reports to the city administrator. The fire chief is appointed by the administrator, with the approval of the city manager.

Figure 1 shows the organizational chart for the fire services unit; it is a hierarchical/structural organizational chart. Neither a functional or position/billet assignment organizational chart was provided for this analysis. Figure 1 has combined elements of each of the aforementioned charts. The overall appearance could be confusing to the average citizen trying to understand departmental organization, as functional areas are grouped with position titles.

Figure 1. City of Ann Arbor Fire Department Organizational Chart (Current)



Each of the different types of organizational charts can be useful in providing clarity, both internally and externally, as to the reporting relationships within the department and the services it provides. Organizational charts make it easier for people to understand large amounts of information as a visual picture rather than a table of names and numbers, or in this case, a conglomeration of information. They are especially helpful to new employees for understanding their place within the organization.[1] Figure 2 illustrates a revised hierarchal chart for the Ann Arbor Fire Department.

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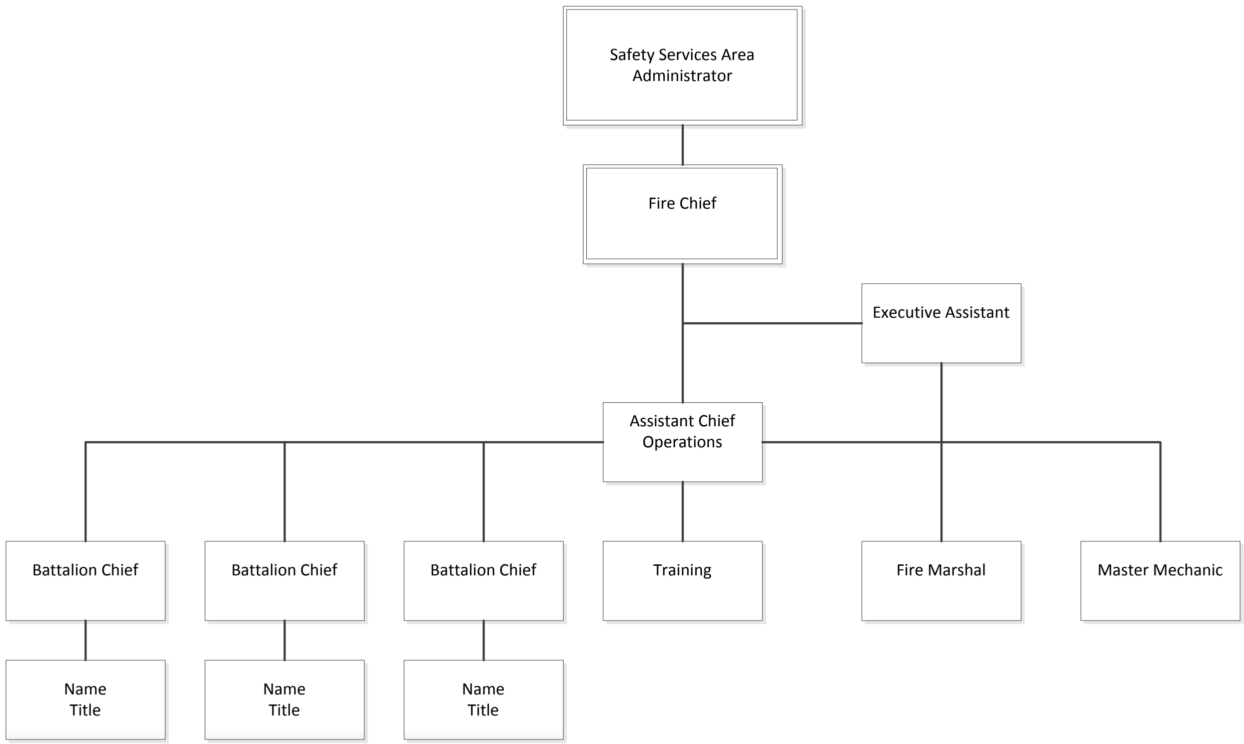
[1] http://smallbusiness.chron.com/definition-organization-chart-2698.html.

Figure 2. City of Ann Arbor Fire Department Organizational Chart (Proposed)

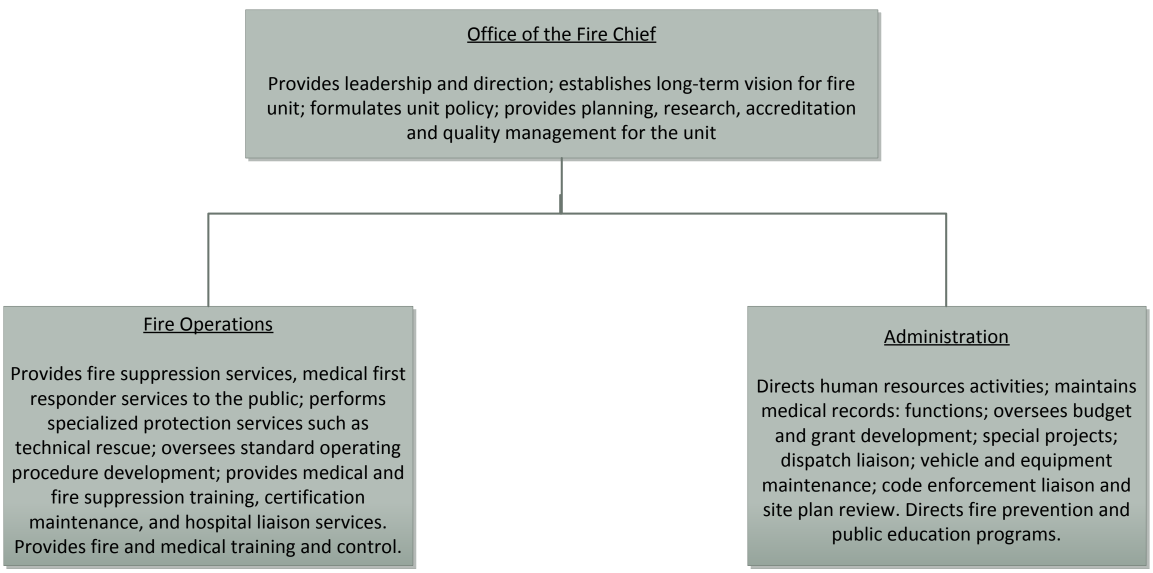


Specific changes to the chart in Figure 2 include elimination of the station coordinator designations in the Battalion 1, 2, and 3 position boxes; elimination of a dispatch liaison position responsibility in the Battalion 3 position box; and elimination of the dispatch liaison responsibility from the assistant fire chief administration box. The rationale for this is that battalion chiefs are on twenty-four hour assignment, which makes them more readily accessible to dispatch center staff than a forty hour position of an assistant chief. Each battalion chief should assume responsibility for providing this service to the dispatch center on a daily basis. Also, the functional designations associated with the position titles have been removed and added to a functional table of organization chart.

Recommendation # 1: Reassign dispatch liaison responsibilities from Assistant Fire Chief for Administration to each on-duty battalion chief. Remove functional area titles to functional table of organization.

A functional chart (Figure 3) builds on the hierarchal/structural chart by providing a full description of the activities undertaken within the area. This is also an ideal location to list fiscal year (past and present) full-time and part-time equivalent employee totals.

Figure 3. City of Ann Arbor Fire Unit Functional Chart (Proposed)



Although the task of developing a position/billet chart for a large organization can be time consuming and can seem unnecessary due to the periodic staffing changes, it can be beneficial to both the organization and the public at large.

Recommendation # 2: Develop separate functional and position/billet organizational charts.

1. Organizational Structure

The basic organizational principles of division of labor within the AAFD are common to the majority of career, combination, and volunteer fire service organizations. Work is divided based on functions that must be performed e.g. fire operations, fire prevention, and training activities. Personnel serving in line functions, that is, activities directly involved in delivering services to the public, also have assumed certain staff responsibilities. For example, a battalion chief may be assigned oversight of the training function. This is appropriate when productivity levels associated with fire suppression positions are decreased.

B. Assessment and Planning

Deciding how many emergency response resources to deploy, and where, is not an exact science. The final decision on a deployment model is based on a combination of risk analysis, professional judgment, and the city's willingness to accept more or less risk. Accepting more risk generally means that fewer resources are deployed, though deploying more resources is no guarantee that loss will be less, especially in the short term. Many sources are available for use in the evaluation and analysis of public fire protection. The following can be referenced by city administrators and elected officials to help in the decision-making process.

National Fire Protection Association. The National Fire Protection Association (NFPA) is an international, nonprofit organization dedicated to reducing the worldwide burden of fire and other hazards on the quality of life by developing and advocating scientifically based consensus codes and standards, research, training, and education. It is important to note that not all NFPA standards are scientifically based. 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, 2010 Edition," is not based on scientific research, but rather has been adopted by a majority vote reflecting experience and opinion of a committee, within which there is much disagreement. There is no published information on the expected reductions in losses or injuries as a function of increased staffing and only a little on the effect of increased response times. Even though it was formulated largely on the basis of expert opinions and task sequencing (what must be done and how many people it takes to do it) rather than research, NFPA 1710 has become the de facto benchmark for the emergency response community. However, the NFPA standard has not been embraced by some groups, including ICMA.

The NFPA recommendations are standards and guidelines developed by committees of chief officers, volunteer representatives, union officials, and industry representatives. Although the NFPA's standards are not legally binding, they are often codified into local ordinances. It is important therefore to consider NFPA standards whether or not they are adopted locally. They remain a widely used criterion for evaluating different levels of fire and emergency service organizations.

Commission on Fire Accreditation International (CFAI). Another highly influential group, the CFAI consists of representatives from the International Association of Fire Chiefs (IAFC) and ICMA. The CFAI and its accreditation process were designed to establish industrywide performance measures for overall organizational performance. Implementing the standard for a jurisdiction is purely voluntary. While a small fraction of fire departments across the nation have gone through the accreditation process and others are working toward that goal, most departments are focusing on the creation of a standards of cover (SOC) document (one of four items required for accreditation). The SOC concept has become so useful that the CFAI has expanded the original 44-page chapter into a 190+ page "how-to" self-assessment manual. The CFAI does not make many explicit recommendations on standards for fire/EMS departments to adopt. Rather, it encourages a thorough assessment of risks in the community, public expectations, and the resources needed to meet expectations given the risks. The creation of written standards should be based on that assessment.

Occupational Safety and Health Administration (OSHA). OSHA develops regulations to protect workers from occupational injuries and illnesses. Of the many regulations that apply to firefighting operations, one of the most critical is 29 CFR 1910.134, which addresses requirements for respiratory protection in environments that are immediately dangerous to life or health (IDLH), including structural firefighting. In such cases, personnel are required to work in teams of two, with two personnel operating inside the IDLH environment and two personnel standing by outside the IDLH environment in the event the entry team becomes incapacitated. This regulation is most commonly referred to as the "Two-in/Two-out" rule.

Insurance Services Office (ISO). The ISO is a national insurance engineering service organization that assigns a public protection classification (PPC) to jurisdictions based on fire department services. Insurance companies typically establish insurance rates for individual occupancies or groups of occupancies based on the PPC. PPCs are established using ISO's Fire Suppression Rating Schedule (FSRS). Once widely used by fire departments to evaluate system performance, the FSRS's use is somewhat limited in that it only evaluates fire protection (not EMS, which most fire departments now provide to some degree). Also, the FSRS does not consider efficiency (e.g., how many resources are deployed in comparison to the number of actual calls). Though no longer widely used, ISO ratings are still appropriate to consider as part of a more comprehensive system performance review. ISO standards are useful, not by themselves, but in combination with other assessments.

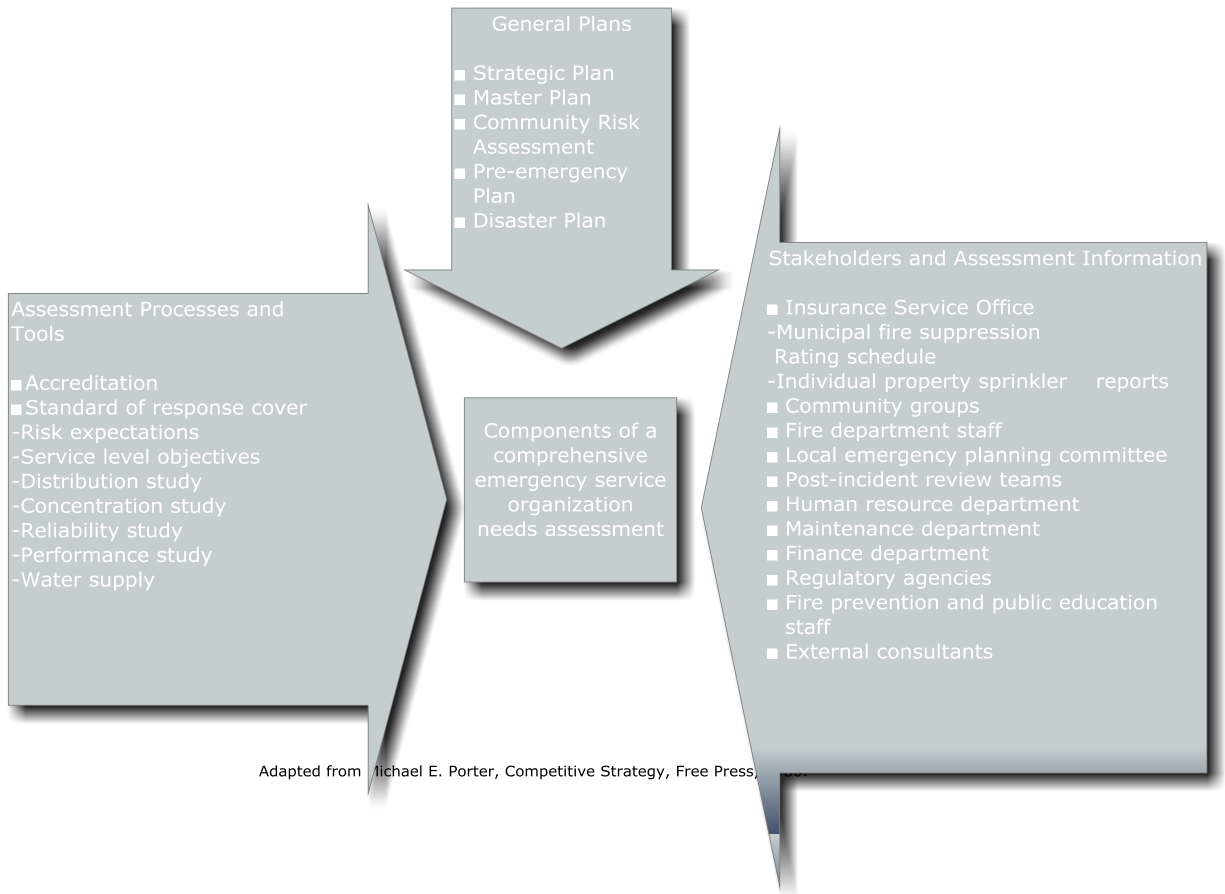
Interjurisdictional Comparisons. Part of the methodology for setting standards includes looking at what similar communities are doing. Comparisons between departments that are similar in size, scope, and complexity and that offer the same range of services are important for assessing why one department falls below or above the average. Even though each community can be quite different with regard to demographics, population density, hazards, and environment, to name a few comparable factors, comparisons are still useful in raising questions related to system performance. This form of benchmarking will be discussed later in the report.

1. Community Risk Assessment

Every fire department should conduct and periodically update a community fire risk analysis or assessment as part of a comprehensive needs assessment. This process enables the department to determine what assets within the community are at risk and what resources are available or needed to effectively deal with them. The AAFD has not conducted such an analysis within its jurisdiction.

The use of a standard methodology for classifying and recording a community's risks could be beneficial in a number of ways. First, the information gathered can be assembled into a database for use when needed and for training and routine communication. Second, because fire is not the only risk faced by a community, asset information can be used in the development and revision of disaster plans. Finally, the information can be used for the purpose of meeting fire department accreditation requirements.

Figure 4. Components of a Comprehensive Emergency Service Organization Needs Assessmet.



A universal tool that allows the entire community to be evaluated in relation to the risk of fire is called Vision™, available through a private company called Emergency Reporting™. This product replaced the Risk, Hazard and Value Evaluation software once available at no cost through the U.S. Fire Administration. Although mentioned here, ICMA does not directly endorse this product. It only serves as an example of what may be available on the open market for this purpose.

The basic premise of the assessment process is to enable a department to derive a fire risk score for each property, which can then be used to categorize the property as one of low, moderate, or high/maximum risk.

Once completed, the risk ratings of individual properties can then be aggregated to establish a risk level of low, moderate, or high/maximum for each geographic area of the community. These ratings are then used to determine the appropriate level of fire suppression resources needed in the form of equipment, personnel, and vehicles to be deployed for the initial arriving unit, the full alarm assignment, and any additional alarm assignments for each level of risk. Just as the SOC establishes policies for analyzing hazards and determining needs, so does the assessment tool of fire department accreditation.

The accreditation process managed by the Commission on Fire Accreditation International (CFAI) and established through the Center for Public Safety Excellence provides an analytical self-assessment process to evaluate ten categories. This detailed self-assessment causes managers to examine more than 240 separate performance indicators, 98 of which are considered core, or required, competencies. The ten categories are: governance, risk assessment, goals and objectives, finance elements, program elements, human resource practices, physical assets and facilities, training and competency assurance, internal support structure, and external support.

Integrated within these categories is an expectation for the community to analyze itself by planning zones and for each planning zone to identify the hazards posed. The community then ranks the hazards by potential severity to ensure that the appropriate resources are available to manage the hazards. There is a cost associated with the accreditation process conducted by the CFAI; however, a department can purchase the standards of cover manual and its accompanying self-assessment manual at a nominal fee of less than $200. Even if the department chooses not to pursue formal accreditation, it should consider using self-assessment reference materials as a blueprint for improving overall fire department administration and operations.

Recommendation #3: Conduct a community risk analysis using the Vision™ risk assessment software or other similar product to classify individual properties within the community.

Recommendation #4: Adopt a strategic goal of achieving fire department accreditation within a specific time period.

2. Strategic Planning

Because the primary goal of a fire department is to prevent fires and – when they do occur – eliminate loss of life and reduce property loss, the strategic planning process is essential in determining the levels of resources needed to meet the community's needs for services. According to ICMA, the strategic planning process must include a fire risk assessment of the community, an internal audit (quality assurance of current services provided by the department), and a written strategic plan that projects fire department goals over a minimum of five years.[2] The AAFD published its five year strategic plan in July 2008. The document is comprehensive in scope and covers a wide range of needs and associated costs for implementation.

The following observations were made in review of the AAFD strategic plan:

First, there is no evidence that an environmental scan took place. This is a critical step in understanding fully the external factors that will influence the direction and goals of the organization. It includes both present and future factors that might affect the department. For example, in the case of the City of Ann Arbor, an environmental scan might indicate that the number of

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[2] Dennis Compton and John Granito, editors, *Managing Fire and Rescue Services,* (ICMA, 2002), p. 39.

students attending the university may increase/decrease to a significant degree. This would undoubtedly have an effect on the appropriate level of service needed.

Second, the plan does not identify the strengths and weaknesses of the department, and the opportunities and threats it faces. This is also referred to as a **s**trength, **w**eakness, **o**pportunities, and **t**hreats (SWOT) analysis. The fundamental question that should be asked is: What are the dependent and independent variables that shape the organization's present working conditions? It is after this process has been completed that the formulation of goals and objectives can be achieved. The results of the SWOT analysis should be a part of either the business or strategic plan or both.

Third, although goals are clearly defined, enabling objectives are not. Instead the document uses "assumptions" and "plan/implementation" as terms to expand on the issues associated with a particular goal instead of focusing on the actions needed to accomplish them. The goals and objectives established by the department are derived from the initiatives identified within its strategic plan. Although the AAFD Strategic Plan and Operational Guide represent a thoughtful approach to addressing future needs of the department, it does not include any associated short- or long-term objectives. These are the practical steps needed to help ensure the achievement of stated goals. The revision of the department strategic plan to include goals and objectives has been mentioned previously in this report.

Fourth, there are no time constraints within the AAFD document, thus leaving open the time to completion. This creates a problem in terms of identifiable goal achievement.

Finally, although the AAFD does identify costs associated with each goal, it is unclear whether these costs were linked to the then current or future budget appropriations.

Recommendation #5: Revise the strategic plan to develop measurable and time-bound goals and objectives based on use of current environmental scan and SWOT analysis.

Although specific public safety initiatives are delineated within the AAFD strategic plan, there is not an accompanying business plan to ensure goal achievement. According to ICMA, business planning in fire and rescue organizations is:

> The process of arriving at a document that outlines how the organization will achieve its objectives in conjunction with the fiscal constraints set by the budget process. The document outlines both the major tasks to be performed to a specified level of service (e.g., responding in a certain number of minutes in at least a certain percentage of calls, or having a certain number of firefighters on the scene within a certain number of minutes for at least a certain percentage of all reported working fires) and the associated costs.[3]

There are many benefits associated with a business plan, for one, it is an outline of performance measures that makes it an accountability document. Performance measures and their significance will be discussed later in the report. The business plan in concept is developed in conjunction with the department's budget. Although the AAFD strategic plan does identify costs associated with specific goals, in our review of current and past budget documents, there is no evidence of there being a link between the two documents.

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[3] Ibid, p. 173.

In addition to the need for a business plan, there also exists the need to develop an action or work plan. This should be initiated at the operational level within each functional area. An action plan supports the strategies outlined in the strategic plan by identifying the specific tasks (tactics) to be carried out, what person or persons is responsible for their completion, and within what timeframe. This is absolutely necessary for monitoring the progress toward goal achievement.

Recommendation #6: Develop department business and action plans for monitoring performance.

3. Master Plan

According to “Leading Community Risk,” published by the U.S. Fire Administration, National Fire Academy, in 2003, a master plan helps identify priorities and levels of service provided in specific operational areas. It can assist in addressing adequacy and performance and align specific divisional needs with organizational expectations and the strategic plan. Therefore, its development can serve as a component of a comprehensive needs assessment and hazard analysis. It differs from a strategic plan in that a master plan typically determines how much risk a community is willing to assume specifically relating to fire protection.[4] AAFD does not have in place a master plan by this definition.

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[4] John Granito, ”Planning for Public Fire-Rescue Protection,”. in *Fire Protection Handbook (20th Edition), Volume II*, (National Fire Protection Association, 2008).

Recommendation #7: Develop a fire protection master plan for City of Ann Arbor and which is approved by city elected officials.

C. Financial Performance

The AAFD uses the most common budgetary format for public sector organizations, which is the line-item budget. This format focuses on inputs (the objects of expenditure) rather than output (results or services). The disadvantages associated with this budgeting format for a service-based entity such as a public safety department are many. This report will not attempt to debate the chosen budgeting format used by the City of Ann Arbor. It is only referenced here to point out the challenge faced when using it to deploy resources within a service-based environment. The adoption of performance measures, more specifically outcome or effectiveness measures to assess quality service and service results, will be discussed later in the report.

1. Financial Benchmarking

Tables 1, 2, and 3 represent comparative data among fire departments within the region. The use of comparative information has long been questioned for its reliability in determining the appropriate level of resources needed for a specific community. It is only cited here to gain some perspective on how other municipalities are using their resources to provide fire protection services within their jurisdictions.

Table 1. Fire Department Population and Budget Comparison

Fire Department	Population (2010 U.S. Census)	Population Density/Sq. mi.	FD Budget (FY 10-11)	FF Per Capita	Cost Per Capita
Ann Arbor	**113,934**	**4,219**	**$14,137,390**	**0.83**	**$124.0**
Flint	**102,434**	**3,048**	**$11,678,903**	**0.98**	**$114.0**
Lansing	114,297	3,174	$28,996,300	2.06	$253.7
Livonia	96,942	2,814	$11,311,428	0.88	$116.7
Sterling Heights	129,699	3,534	$18,301,770	0.76	$141.1
Warren	134,056	3,908	$18,301,770	0.74	$136.5

As seen in Table 1, the City of Ann Arbor's spending for fire protection services and its number of firefighters per capita is in line with other fire departments operating within cities of similar size and density in the region.

Another comparison that could be made between the City of Ann Arbor and its level of fire protection and other cities with similar attributes is that of resident universities. The City of Ann Arbor is home to the University of Michigan, which is the foremost institution in the city.

To compare Ann Arbor's fire department with those in similar-size cities with a major university, we surveyed a national list of communities with four-year colleges/universities having enrollments of at least 1,500 students. The total fall 2000 student enrollments were compared to the general 2000 population figure in each community. Cities were grouped by size and thresholds set for student population in each. Cities that had student enrollments below those thresholds were excluded from the survey. Because the goal of the survey was to find cities where colleges acted as engines for cultural and economic growth beyond the campus, communities where the ratio of students to general population exceeded 3:4 were screened out. Cities were grouped in four categories:[5]

- Big cities: 300,000 or more population
- Medium-sized cities: 100,000 to 299,999
- Small Cities: 20,000 to 99,999
- Towns: up to 19,999.

Table 2. Fire Departments in Cities with Four-year Colleges/Universities with Enrollment of ≥1,500 Students

City/State	*Rank	Pop. (2010)	Dept. Budget FY10-11	No. F/F	F/F per capita	Cost per capita	Cost per Firefighter
Ann Arbor, MI	5	113,934	$14,137,390	94	0.83	$124.0	$150,397.8
Berkeley, CA	6	112,580	$25,529,606	136	1.2	$226.8	$187,717.7
Athens, GA	7	115,452	$13,049,400	190	1.7	$113.0	$68,681.1
Provo, UT	10	112,488	$7,584,969	77	0.68	$67.4	$98,506.1

*Rank refers to the position of the city within its size group

Among the four cities listed in Table 2 and which are comparable from a population perspective and considering selected variables, Ann Arbor falls within the ranges exhibited by its contemporaries.

And again, another level of comparison between fire departments of similar size is the service level provided. Table 3 looks at the type of organization, the level of service, and specific aspects of deployment resources for cities within the region.

[5] Retrieved November 2, 2011, from http://www.epodunk.com/top10colleges/methodology.htm.

Table 3. Fire Department Service Level and Resource Deployment

Fire Department	Type	EMS Transport	No. of Stations	Paid Firefighters
Ann Arbor	Paid	No	5	94
Flint	Paid	No	8	105
Lansing	Paid	Yes	8	154
Livonia	Paid	Yes	6	82
Sterling Heights	Paid	No	5	99
Warren	Paid	No	6	120

Note: Firefighter count includes administrative positions.

It should be noted here that fire departments offering EMS transport service typically employ higher staffing levels than those that do not. The Livonia Fire Department, although at a slightly lower population census, is able to offer EMS transport service at a lower staffing level than AAFD.

2. Union Contractual Agreement

In our review of the collective bargaining agreement (CBA) between International Association of Firefighters (IAFF) Local 693 and the City of Ann Arbor, we noted some stipulations that are hard to justify given the difficult economic times. One of these is Article 47, "Food Allowance." It states:

> Effective July 1, 2005, Fire Department personnel working 50.4 hour duty week shall receive a food allowance of $12.00 per day (minimum 12 hour shift) worked (on or offsite). Payment will not be made for days when an employee is on code, sick, vacation, comp, etc. This payment shall be made monthly (with the second pay period of the month) for the previous month.

Table 4 shows expenditures by the department for food allowances during a five-year period.

Table 4. AAFD Food Allowance Expenditures

Fiscal Year 2007	Fiscal Year 2008	Fiscal Year 2009	Fiscal Year 2010	Fiscal Year 2011, to date
$90,240	$89,796	$89,016	$89,988	$72,564

Over the past five years, the city has averaged more than $86,000 in food allowance cost. Given the city's current financial situation, it is difficult to justify to community stakeholders why such an agreement exists. ICMA staff is not aware of any collective bargaining agreements within recent history offering such lucrative benefits.

Another issue pertaining to the CBA that warrants revisiting is that of Training and Education. Article 37A (3) states:

> Full reimbursement will be provided for registration, tuition and books, but not travel or employee time. Effective July 1, 2004, approved reimbursement is contingent upon the employee receiving a satisfactory grade as outlined in Section 4 A of this Article for course/s and textbooks at up to 100% of the total costs up to a maximum of two thousand, five hundred ($2,500) dollars per fiscal year.

A fair and equitable approach to providing city employees with educational incentives would be to offer 50 percent reimbursement costs for tuition with the employee contributing all costs for textbooks and/or other materials. A plan offering 100 percent reimbursement far exceeds that offered by the majority of municipalities.

A third issue pertaining to the CBA that we suggest reviewing is employee health insurance coverage, under Article 53(A) 1, 2, & 3, Hospitalization, Dental, Optical. Basically, the policy provides health insurance coverage for all active and retired bargaining unit employees and their dependents at no cost. Normally, employee health insurance contributions can vary from company to company and state to state, ranging anywhere from 25 to 50 percent of the cost.[6] This benefit represents a substantial allocation of city funds that is out of line with what is usually provided to employees elsewhere in the country. Based on a study conducted by the Bureau of Labor Statistics in March 2009[7], state and local public employers require union employees to pay an average of 19 percent of medical policy premiums for family coverage and 9 percent for single plans. It was also noted that while these are nationwide statistics, there are variations across regions with the heavily unionized employees in the Northeast being able to negotiate more favorable terms. Notwithstanding the regional differences, the city should make a concerted effort to more closely conform to the national norm.

Recommendation #8: Consider reopening CBA with Local 693 to renegotiate articles concerning food allowances, tuition reimbursement, and health insurance coverage.

[6] Author. "What is the normal employee contribution for health insurance?" Retrieved October 16, 2011 from http://www.insuranceproviders.com/normal-employee-contribution-percentage-health-insurance

[7] Bureau of Labor Statistics, Employee Benefits in the United States, March 2009, Page 7 and Page 9

D. Programs

1. Fire Suppression

The AAFD employs the traditional concept in its organization of fire suppression services. It centers on the basic tactical unit of the fire department: a group of personnel operating one or more pieces of apparatus under the supervision of a company officer. Several companies operate out of some fire stations. Engines and ladder companies are deployed from these static positions, along with specialty units such as battalion commanders, rescue squads, and hazardous materials vehicles. Ladder or aerial units are deployed in keeping with the NFPA suggested standard of one ladder unit to two to three engine companies.

a. Resource deployment

How many firefighters and stations does a community need? These are questions that have vexed local government decision makers for many years and no doubt will continue to do so far into the future. The debate that rages has at times become more emotional than analytical in nature. Pressure from some politically involved professional organizations would have fire stations within a drive time radius of every one and one-half miles, with four to five personnel staffing every response vehicle. Truth however lies not in how powerful, credible, or loud an organization raises its voice to promote its agenda, but in realities of answers to specific questions. In other words, process, not product, defines fire service deployment analysis.[8]

For the most part, fire departments have evolved around certain standards/recommendations that in some circles have taken on the effect of

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[8] Retrieved from October 17, 2011 from http://www.fireengineering.com/articles/print/volume-152/issue-8/features/fire-service-de...

law. If a department does not conform to an association's guidelines, then according to its advocates, it not only violates a legal precedence, but from a moral perspective, safe operating practices as well. This could not be further from the truth.

Take for example the ISO Fire Service Rating Schedule (FSRS). The ISO clearly states that its ratings are intended for insurance purposes only.[9] The FSRS as a guide to deployment of fire apparatus and prediction of community fire loss has been questioned and there is mixed evidence for consistency of ISO fire suppression ratings with community fire losses.[10] Nevertheless, the fire protection professional community remains adamant in the use of the FSRS as a rationale for retention of personnel, stations, or apparatus. This is particularly true with regard to travel distances for stations from built-up areas. The FSRS is based on the avoidance of a conflagration (a large disastrous fire), which stems from a concern about low-frequency, high-severity property loss events such as fully-involved building fires and their potential for extension to adjacent structures. Somewhere in all of this exists a rational approach to determining what is the appropriate number of fire stations and sufficient staffing for emergency response units.

b. Use of technology in staffing and deployment strategies

In the AAFD, a fire company is composed of a minimum of three people using an engine, ladder/tower, or rescue as a response vehicle. Of the five fire stations within the city, only station number one employs multiple companies each using three-person minimum staffing.

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[9] John Granito "Evaluation and planning in public fire protection." (as cited in Jennings, C. Ed. Proceedings of First International Congress on Fire Service Deployment Analysis, VA: The Institution of Fire Engineers, 1999.
[10] Ibid.

Technological advances have been made in fire extinguishment to supplement the overall effectiveness and efficiency of a reduced workforce. These advances have introduced viable alternatives to meeting NFPA minimum staffing recommendations. Two primary innovations to be considered in limited staffing situations are a compressed air foam system (CAFS) and the Ara Safety Pro™ Fire Interruption Technology® (FIT) knockdown tool. Both are available commercially and both have amassed vast anecdotal references substantiating their effectiveness within the firefighting community.

Although ICMA does not endorse products, subject matter experts involved with development of this report have witnessed first-hand the effectiveness of such devices. A trial test of a similar product was conducted by the Volusia County Fire Rescue department in Volusia County Florida in September 2011. Tests results confirmed the manufacturer's claims that use of this device not only extinguished the fire in an extremely short time frame, but eliminated the need for firefighters to enter the immediately dangerous to life and health environment until the fire had been extinguished or knocked to down to temperature and flame levels acceptable for safe firefighter entry.

Compressed air foam systems were introduced and advocated for structural firefighting in the 1990s as a way to provide greater fire knock-down power, and to decrease water usage, hose line weight, and water damage. CAFS is now slowly becoming viewed as a possible way to offset reduced staffing policies among career fire service organizations and decreased volunteerism among volunteer and combination departments.

So what is CAFS? It is a pumping and delivery system that mixes water, foam solution, and compressed air.

The use of CAFS as a primary fire attack tool is now being proposed in the UK; the East Sussex Fire & Rescue Brigade has two years of experience with operational trials in structure fires. The brigade has several frontline fire engines equipped with the German-made Schmitz GmbH 'One Seven' system. Other brigades across the UK are fast following this innovative approach.

The growing acceptance of CAFS is being driven by fire leaders who see an opportunity for a simple system of primary fire attack that well replace the high-pressure water-fog system. CAFS appears to offer increased performance in fire suppression of post-flashover fire and possibly pre-flashover situations. It reduces the amount of water needed to suppress a vast majority of fires, so primary water tanks and fire engines can be downsized, possibly fewer firefighters are needed, and attacks on a fire can be made from a safer distance. Further still, the costs associated with training firefighters in primary fire attack may well be reduced substantially.[11]

Closer to home, the effects of CAFS on needed manpower for suppression activities are well-documented in the literature and have been consistently observed, both in actual fireground situations and in simulated exercises.[12] For example, controlled room and contents fire tests utilizing CAFS were performed at Wallops Island, Virginia, and Salem, Connecticut, by Hale Fire Pump, the Atlantic Virginia Fire Department, Ansul Fire Protection, the International Society of Fire Service Instructors, Elkhart Brass, the National Aeronautics and Space Administration-Goddard Flight Center Fire Department, the Charlotte, North Carolina, Fire Department, the Fairfax County, Virginia, Fire Department, F.l.E.R.O. (Fire Industry Equipment

[11] http://www.firetactics.com/CAFS.htm.
[12] http://www.cafsinfo.com/cafs_limited_staffing.html.

Research Organization), and the Salem Connecticut Fire Department. Table 5 shows the results of these tests.[13]

Table 5. Temperature Drops™ High Level -1000 Degrees F. Down To 212 Degrees F.

Medium	Time (Seconds)	Drop Rate (Degrees F. per Sec.)
Water	222.9	3.5
Foam Solution	102.9	7.6
Compressed Air Foam	38.5	20.5

The table shows the significant difference in temperature drop rate using CAFS as compared to the other extinguishing mediums of plain water and a simple foam solution.

In 1990, the Los Angeles County Fire Department began an intensive evaluation of Class A foam. That led to the specification of direct-injection, multiple-outlet foam proportioners on all new engines starting in 1992. In 1995, the department purchased three engines equipped with compressed-air foam systems. Today, the LACFD has 224 frontline engines, 10 reserve engines, and 15 frontline quints equipped with Class A foam proportioners. An additional 19 frontline engines are equipped with CAFS.[14]

An article entitled "Bubbles Beat Water" in the July 2001 issue of *Fire Chief Magazine,* reports the LA County Fire Department conducted a series of tests in an effort to provide hard numbers on the use of CAFS. One of the misconceptions associated with the use of foam solutions in fire extinguishment is its cost. In the Class A foam/water solution test, LA County personnel used only thirty-one fluid ounces of concentrate to knock

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[13] http://www.firetactics.com/CAFS.htm.
[14] http://www.firetactics.com/CAFS.htm.

down and overhaul a fire in four rooms. At an average cost of $13 per gallon, the test used only $3.10 worth of concentrate. The CAFS test used even less – only six fluid ounces of concentrate, or about sixty cents worth.

Many fire professionals are starting to advocate the benefits of foam as a first-line extinguishing agent compared to water. The A-Foam Authority is a nonprofit trade association created to provide accurate, generic information about the benefits of Class A foam. The A-Foam Authority is comprised of end users (fire chiefs, officers, and firefighters); equipment and foam manufacturers; technical and training specialists; wildland and urban agencies; and other experts in the field of safety and prevention. The A-Foam Authority believes that through research and third-party testing, it can offer statistical data verifying the many benefits of Class A foam, including: increased firefighter safety, quicker extinguishment that will benefit the environment with less air pollution and less water usage, quicker return to service, reduced frequency of rekindles, less smoke and water damage to structures, and less financial impact on the community.[15]

Recommendation # 9: Consider including CAFS in all new fire suppression vehicle specifications and retrofitting specific frontline fire vehicles based on community risk assessment and historical call review.

The manufacturer of the Ara Safety Pro™ Fire Interruption Technology® (FIT) knockdown tool claims that it can deployed in a wide variety of structure fire scenarios, from incipient to fully involved, as well as in defensive, offensive, and transitional modes. In some fireground situations, water may be unavailable, the duty commander may be on site before

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[15] http://afoam.org/about.cfm.

working crews and trucks, or an EMS call may leave the crew short for the two-in and two-out rule.[16] The tool can be used to supplant firefighting forces and mitigate the effects of fire in the incipient stages, thereby reducing the risk of flashover. Reducing the risk to firefighters and the public is always of primary concern. The device is made for use by professional firefighters only and proper training in its deployment is required. Current pricing stands at approximately $1,000 per tool.

One of the most significant aspects in the use of this new technology is the fact that interior attacks can be initiated through a door or window. This allows greater stand-off distances and thus reduces the risks to firefighters.

Recommendation #10: Consider purchase of fire interruption tools for placement on all fire suppression, rescue and command vehicles.

c. Vehicles and equipment

A fire department's reliance on the proper vehicles and equipment in order carry out its mission can never be underestimated. There is no national standard or recommendations for the replacement of emergency vehicles. The decision is left to each locality and represents a balancing of numerous factors: fire activity levels, maintenance and cost history, individual vehicle reliability, funding availability, technological changes, firefighter safety, and vehicle use.[17]

The use of full-size suppression apparatus is giving way to a much more measured approach in vehicle acquisition and deployment. However, this

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[16] http://www.arasafety.com/products/arasafetypro.htm.
[17] Dennis Compton and John Granito, editors, *Managing Fire and Rescue Services*, (ICMA, 2002), p. 213.

approach to vehicle purchasing has not yet found its way into the AAFD. It is no longer practical to provide each geographic area within a jurisdiction with the traditional suppression apparatus without conducting a comprehensive analysis of what is needed to meet the level of risk assessed. Many departments, both large and small, are beginning to make purchasing decisions for vehicle replacement based on perceived risk rather than using a "one size fits all" mentality. There a number of manufacturers producing smaller, mid-size pumpers. These vehicles have all the firefighting functions of their larger counterparts; water pumps, water tanks, and ladders are all a part of the package. Further, the industry is evolving toward the use of even smaller firefighting apparatus termed "quick response vehicles," or QRV, to use in place of more traditional vehicles. Figure 5 shows a typical QRV.

Figure 5. QRV Deployed as Frontline Fire Suppression Vehicle

In addition to substantial cost savings in the initial purchase, with a QRV maintenance expenditures are reduced significantly. These vehicles can be equipped with CAFS, thus providing an effective initial fire attack at lower cost.

Recommendation #11: Consider acquisition of medium-size pumper for operations deployment within fire districts based on historical fire call requirements and projected community growth trends.

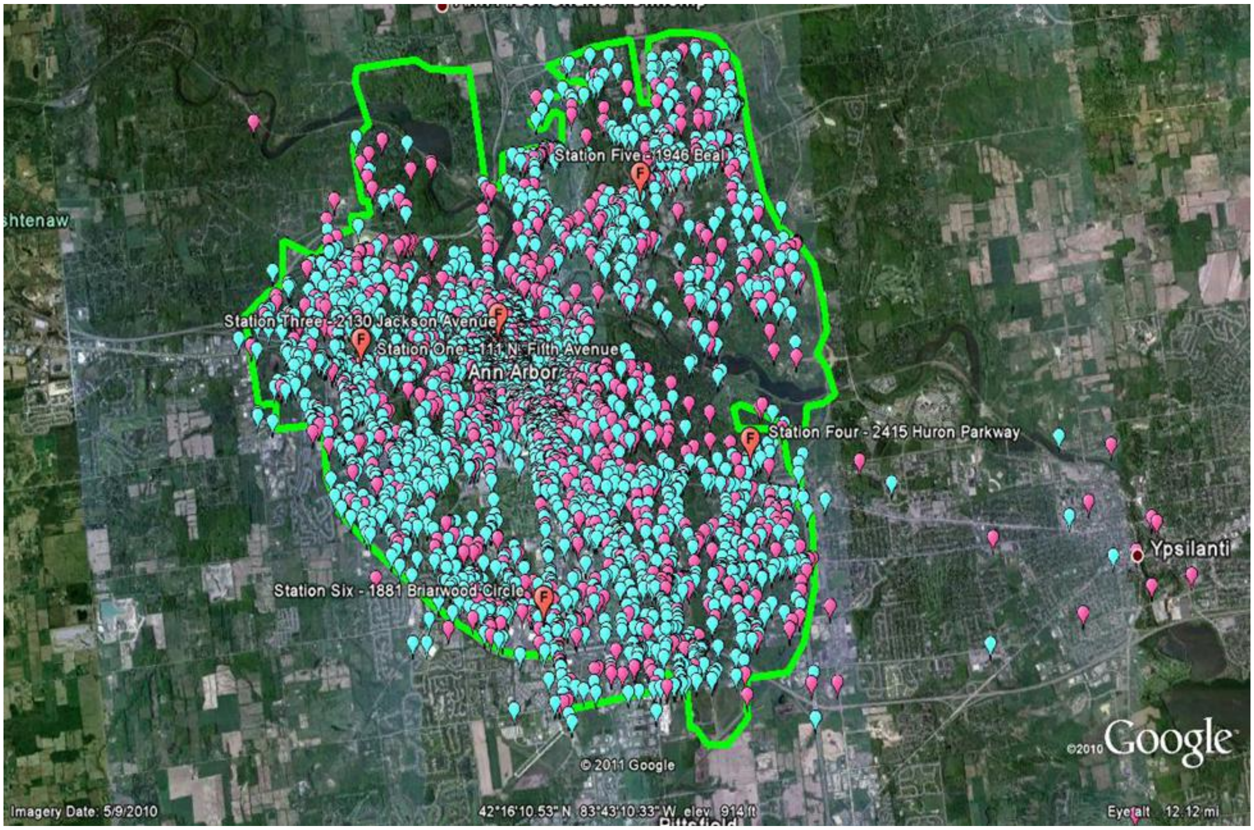
d. Alternative fire suppression staffing and deployment model

The preceding information regarding innovative technologies available within the fire service makes the use of alternative methods of resource deployment viable. The use of a mid-size pumper or a QRV equipped with fire suppression tools such as CAFS or the fire interruption tools could enable a department to reduce staffing to as low as two firefighters per unit. This approach is not being advocated in all deployment situations, but could be a viable option in areas where consideration of external factors regarding risk assessment is favorable for its use.

e. Geographic information systems

Computer software programs can make both problem analysis and solution-path identification easier. This technology allows various data to be presented in graphical form tied to maps of the community. GIS brings additional information power to fire personnel for hazards evaluation, service demand analysis, and resource deployment. GIS can be used to perform complex incident analysis to display trends, illustrate patterns, and identify areas of high call volume. A comprehensive GIS-based fire station location study can be the central component for a master plan. Figures 6, 7, 8, and 9 have been developed using GIS technology. They illustrate fire and EMS call volume and density in the City of Ann Arbor covering service calls between March 1, 2010 and February 28, 2011.

Figure 6. Fire and EMS Calls in the City of Ann Arbor



Key for Figures 6-9: Blue balloons = EMS Calls; Magenta balloons = Fire calls; Red balloons (F) = fire stations.

Figure 7. Fire Calls in the City of Ann Arbor

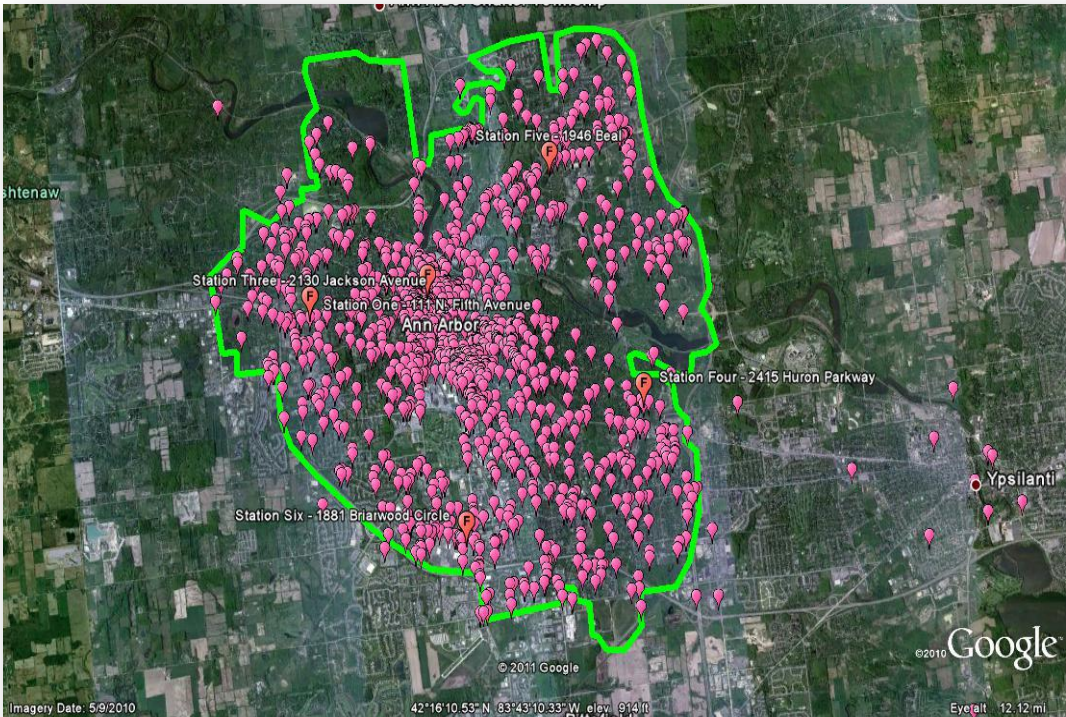


Figure 8. EMS Call Density in the City of Ann Arbor

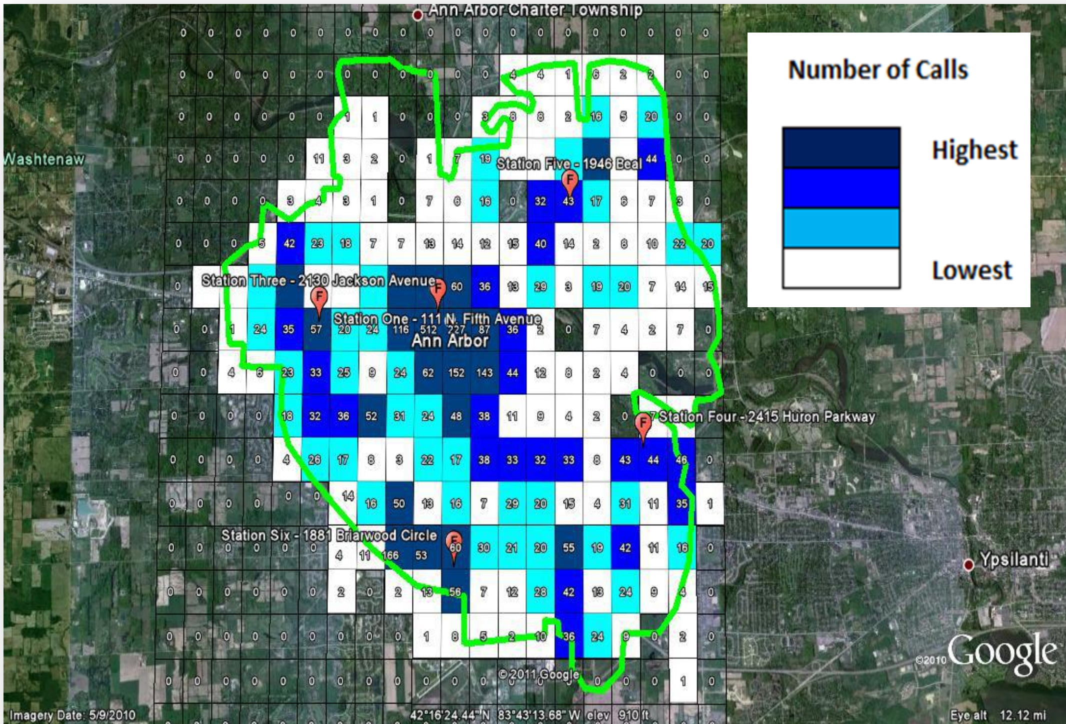


Figure 8 illustrates EMS call density by grid relative to fire station locations. The highest call volume during the study period is in close proximity to current active fire stations. This indicates good site placement for emergency response units.

Figure 9. Fire Call Density by Grid in the City of Ann Arbor

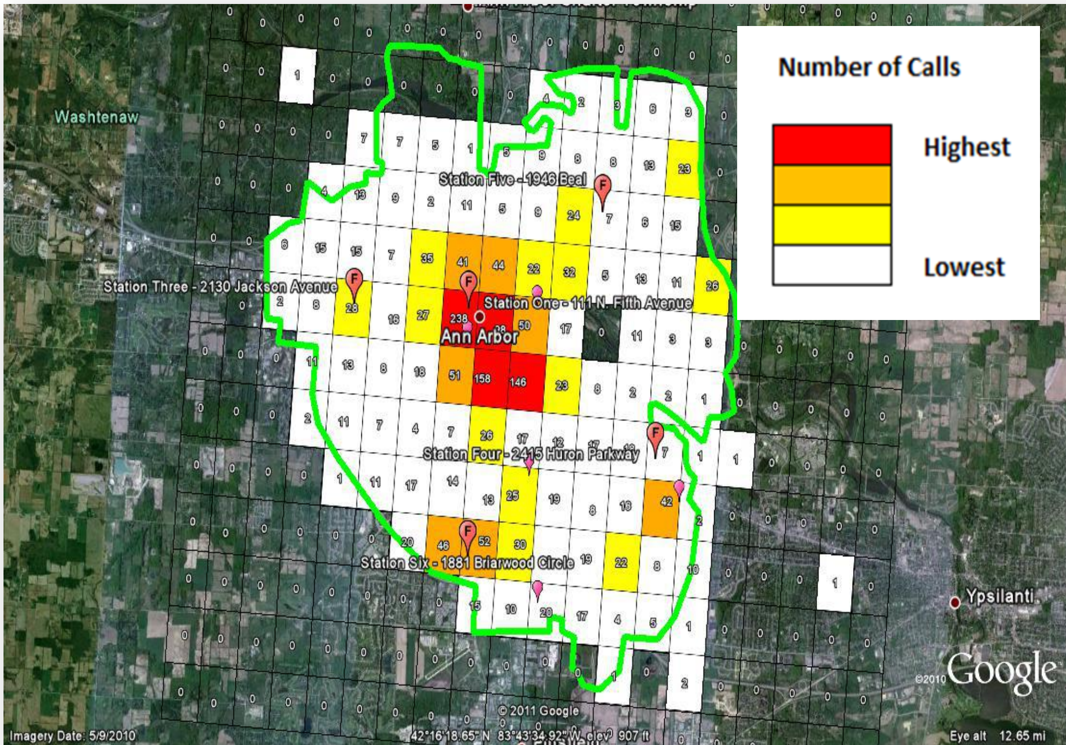


Figure 9 illustrates fire station location relative to fire call density during the study period. This is indicative of good site placement for emergency response units.

f. Workload

As fire calls continue to decrease, so can the productivity of fire units. Fire departments have attempted to counter these effects by engaging fire personnel in various activities outside of their normal responsibilities. These include fire safety inspections and public presentations. In addition to normal day-to-day responsibilities, fire personnel in the AAFD are being utilized to carry out additional tasks. Table 6 shows the engine company workload.

Table 6. AAFD Emergency Response Unit Workloads

Rank	Unit	EMS %	Fire %	Total Annual Runs	Actual Fire %
1	R1-1	79.6	20.4	2,297	NR
2	E1-6	64.7	35.3	1,347	15.9
3	E1-4	63.5	36.5	1,229	17.4
4	E1-3	69.9	30.1	1,072	16.0
5	TW1-1	21.0	78.4	1,029	2.04
6	L1-5	62.7	37.3	1,006	15.3

Note: Figures are for period beginning March 1, 2010 through February 28, 2011. NR = Not Recorded

Engine 1-6 ranked number one in total number of all responses for fire suppression units including EMS and fire. For each of the three busiest fire units, EMS calls consumed more than 60 percent of engine company workload. In the case of R1-1, EMS comprised almost eighty per cent of total call volume. It should be noted that R1-1 is an engine type apparatus with operating water pump and tank. Of the time remaining, actual fire calls totaled roughly fifty percent of all fire calls.

In reviewing the call density map in Figure 9, we see the call volume surrounding fire station 3 and station 4 registers within the lowest quartiles (25 and 52 percent respectively). As with all fire units, these units respond to a majority of EMS calls. An alternative deployment option given the types of calls (EMS) within these response areas would be the deployment of a two-person CAFS unit (light suppression vehicle). This would allow a reduction in staffing by one firefighter at each station. This action would of course require reopening of the collective bargaining agreement between Local 693 and the City of Ann Arbor. The current contract requires that all fire suppression apparatus must be staffed with a minimum of three personnel. The contract defines “fire suppression apparatus” as all ladders, engines, aerials (towers) and heavy rescues.[18] In addition, savings would also be derived from reduced vehicle maintenance and replacement due to the operation of a lighter vehicle.

Recommendation #12: Consider reopening of labor agreement to negotiate deployment of QRV with reduced staffing of one less firefighter each at station 3 and station 4.

The exception is Tower1-1, which responded to far more fire calls than EMS calls. However, 51 percent of its fire calls were alarms (no actual fire). It should be noted here even though TW1-1 is not considered a frontline vehicle (it has been rotated in and out of service), the purpose is to show its rank order in number of responses only.

The high number of false alarm responses is a serious issue in that most fatalities and injuries to firefighters are sustained en route to emergency incidents. False alarms can be attributed to a number of factors, including improper system maintenance, malicious activities, and how alarms are transmitted to the communications center. The exact cause of the false alarms should be investigated and appropriate action taken. If cause is due to improperly maintained systems, then stiffer penalties should be implemented as a means to bring property owners in compliance. Fire departments have also altered their response policies, sending only a single unit to investigate these occurrences rather than a full dispatch assignment.

Recommendation # 13: Investigate cause of false alarms and employ appropriate method(s) to reduce total responses.

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[18] Agreement Between the International Association of Firefighters and the City of Ann Arbor, July 1, 2009 through June 30, 2010, Page 70.

Another issue of concern is the vehicle type used for R1-1 responses. As the data indicates, nearly 80 percent of its responses are to EMS calls. The use of a full-size suppression vehicle for EMS response is inappropriate and costly. The AAFD should move to replace it with a QRV. This could reduce the staffing level to two firefighters.

Recommendation #14: Consider replacing R1-1 suppression type vehicle with a QRV and reduce staffing to two firefighters.

g. Capability and capacity

Two concepts are useful in local suppression considerations. First is the "capability" of the fire department to respond within a short time with sufficient trained personnel and equipment to rescue any trapped occupants and confine the fire to the room of origin or building of origin on initial attack.[19] What is a sufficient number of trained personnel? This question has been debated among fire service professionals for many years and there is every indication it will continue into the future. The NFPA has published national standards which fire officials rely upon to a great extent to answer this question. While the NFPA is a highly respected and creditable organization, bringing many life safety standards into use today, there is little scientific evidence to support its minimum staffing standard. The use of a blanket approach to determine the appropriate level of staffing at a fire emergency is not useful when considering the specific needs of a community.

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[19] John Granito, "Planning for Public Fire-Rescue Protection," in *Fire Protection Handbook, 20th Edition, Volume II*, (National Fire Protection Association, 2008), pp. 12-8.

Many factors affect fire loss and injury rates. Among these may be environmental factors, training and fitness levels, leadership skills and capacity, firefighter accountability and operational management systems, fuel density and types, exposures, and effectiveness of fire programs and operations.[20] Using a method to evaluate local needs, testing the performance of different sized teams against those needs in a series of controlled experiments, and employing the results to guide decisions on appropriate team size is a much more analytical approach to this minimum staffing dilemma.[21]

This is not to suggest that until a department can conduct these tests, and determine what is adequate for its community's fire problem, any number of firefighters at a fire emergency will suffice. The article noted here does suggest that fire departments conduct their own critical tasks analysis to determine the appropriate staffing levels for their community.

Although there has been very little research quantifying fire performance, one thing is common – all have used different sized teams to effect fire extinguishment in a controlled environment using time as a factor. Even the latest study by the National Institute of Standards and Technology to determine the impact of crew size, first-due engine arrival time, and subsequent apparatus arrival times on firefighter safety and effectiveness at a low-hazard residential structure fire could not discount that there are other factors involved in deployment decisions. The report states:

> While resource deployment is addressed in the context of a single structure type and risk level, it is recognized that public safety policy decisions regarding the cost-benefit of specific deployment decisions are

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[20] C. Lawrence, "Fire Company Staffing Requirements: An Analytical Approach," *Fire Technology*, 37, 199-218.
[21] Ibid.

a function of many other factors including geography, local risks and hazards, available resources, as well as community expectations. This report does not specifically address these other factors.[22]

It is important to note that some fire service professionals now use this study to support their position on minimum daily staffing.

The AAFD currently staffs its fire suppression apparatus (ladders, engines, aerials [towers], and heavy rescue vehicles) with a minimum of three personnel at all times per the CBA. These positions are maintained during the course of the twenty-four hour, three-platoon shift schedule. There is no evidence that AAFD has conducted any performance standards test to determine appropriate crew size for its department based on level of risk assessment and acceptability. It would serve both firefighters and the public if such tests were conducted. There may also be situations in which cross-staffing, such as when a station is staffed with four personnel assigned to two or more apparatus/vehicles, may be an appropriate deployment strategy based on historical run data. Many departments have gone to this level of staffing with crews using the apparatus/vehicle most appropriate to handle the call. An example would be four personnel in one station equipped with a ladder, an engine, and a fly car (vehicle used to respond to EMS calls.)

Recommendation #15: Conduct critical tasks analysis using an historical review of specific fire call requirements and consideration of likely community changes to determine effective/efficient crew size.

[22] J.D. Averill. et al., *Report on Residential Fireground Field Experiments*, (NTIS Technical Note 1661, 2010).

The problem with staffing on a twenty-four hour basis is that it does not take into account system demand levels. What is the purpose of maintaining a constant staffing level over a twenty-four hour period when statistics show that off-peak hours require fewer staffed units? The answer lies in the fact that traditional approaches to service delivery are hard to change.

This staffing approach is certainly not specific to AAFD. The same is evident in any fire deployment strategy using a twenty-four shift schedule. ICMA data analysis observed that hourly busy minutes for fire and EMS calls within the City of Ann Arbor were lowest between 2 a.m. and 8 a.m., averaging fewer than 11.1 minutes per hour. Does an opportunity exist for using the information formulated from this demand analysis to develop alternative resource deployment strategies in the future? Absolutely! The question is: Will it be used? This brings us to the other concept in local suppression considerations, that of "capacity."

Capacity is the ability of the fire department to respond adequately to multiple-alarm incidents ("sustained attacks") and/or simultaneous calls of any type, including emergency medical responses. If alarm patterns are examined, the volume of multiple alarms and simultaneous response demands over a period of time can be approximated.[23] How much of AAFD capacity is used during twenty-four hour period? ICMA data analysis observed that hourly busy minutes for fire and EMS calls were the highest between 10 a.m. and 10 p.m., averaging between 17.6 and 21.7 minutes per hour. On average, two or more AAFD units were involved in simultaneous calls only 12.7 per cent of the time and three or more less than one percent (0.5 percent) of the time. This suggests that ample

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[23] John Granito, "Planning for Public Fire-Rescue Protection," in *Fire Protection Handbook, 20th Edition, Volume II*, (National Fire Protection Association, 2008), pp. 12-8.

capacity remains in the system to handle the possibility of multiple alarms within the City of Ann Arbor.

h. Fire department total reflex time

There are five steps in the fire department total reflex time sequence after receipt of an alarm:[24]

- Dispatch time – amount of time that it takes to receive and process an emergency call. This is manageable by the way that alarms are received and the way that dispatch systems and activities are handled. This includes:
    - Receiving the call
    - Determining the type of emergency
    - Verifying the location of the emergency
    - Determining the resources required to handle the call
    - Notifying the units that are to respond.
- Turnout time – period beginning when units acknowledge notification of the emergency to the initial point of response. The NFPA 1710 recommends turnout time be 80 seconds or less for fire and special operations and 60 seconds for EMS responses.[25] ICMA data analysis show AAFD turnout time to be 2.1 minutes (121 seconds) for EMS and 2.3 minutes for fire responses (120.3 seconds). It may be managed to some degree by improving the method of communications between the dispatch center and the fire station to reduce the amount of time

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[24] R. Johnson, M. Prince,"GIS fir Fire Station Locations and Response Protocols,". in *Fire Protection Handbook (20th Edition), Volume II*, (National Fire Protection Association, 2008), page 12-218.
[25] 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, 2010 Edition, page 7.

processing the alarm notification. It can also be managed by monitoring crew performance to ensure timely exits from fire stations.

- Response time – period beginning when units are en route to the emergency incident and ending when units arrive on the scene (wheel start to wheel stop). This is the most manageable segment of the sequence and can be accomplished by selecting strategic fire station locations based on the amount of time that it takes to travel from the fire station along the most efficient travel route to the incident scene. Total response time would include dispatch time, turnout time, and response or travel time. These three segments are referred to as total response time – not to be confused with "total reflex time" and are what most fire departments track as a performance indicator. The AAFD, however, does not add alarm handling time to its response time data. This information is recorded and maintained for communication center informational purposes. Only turnout time and travel time are recorded for AAFD quarterly and annual reporting purposes. ICMA data indicates AAFD has a response time of 10.4 minutes for EMS calls 90 per cent of the time. This includes alarm handling time, turnout time, and travel time (total response time). This exceeds the NFPA recommended standard of 6.5 minutes for EMS response for the arrival of a unit with first responder with automated external defibrillator or higher level capability at an emergency medical incident. In addition, the NFPA also recommends that a department establish a performance objective of not less than 90 percent for the achievement of each turnout time and travel time.

Recommendation #16: Consider deploying peak load staffing unit with quick response vehicle staffed with two firefighters.

- Access time – time required for the crew to move from where the apparatus/vehicle stops to the emergency.
- Setup time – time required for fire department units to set up, connect hose lines, position ladders, and otherwise to prepare to extinguish the fire.

Although AAFD does not currently track and record access and setup time, both can be used as performance measures toward improving overall efficiency and effectiveness.

Recommendation #17: Consider tracking access time and setup time as part of total fire department reflex time.

ICMA data analysis reveals the greatest opportunities for improvements. According to NFPA standards, fire departments should comply with an 80 second turnout time for fire and special operations and 60 second turnout time for EMS response. The AAFD average turnout time was between 1.8 and 3.1 minutes. The average turnout time between 1 a.m. and 6 a.m. was longer than 2.9 minutes, significantly outside the recommendation.

This could be due to a number of factors. First, the method of communication between the dispatch center and the fire station may be causing a delay in getting the units out of the station faster. Improvements in this area may include equipping response vehicles with mobile data units, upgrading station notification systems to automatically turn on lights and open fire apparatus bay doors, or again, monitoring crew turnout to ensure a timely exit from the fire station. As might be expected, ICMA's analysis indicates increased turnout times during the twenty-four hour shift schedule when crews are sleeping. In review of the current average response time for

AAFD there appears to be opportunities to decrease response time without adding additional stations or resources.

Recommendation #18: Consider upgrading station notification systems, and monitor crew turnout performance.

i. Reducing response times

The most effective way to improve outcomes for both fire and medical emergency response is to reduce response time. By understanding the objectives of each step in the response sequence, a fire department can measure its performance against these objectives. That information provides the necessary framework for assessing the cost of reducing response time during any of these steps. Essentially, the community must decide its desired response and travel time.[26] This statement is worth repeating. The community must decide its desired response and travel time.

It is not the responsibility of the NFPA, ISO, or any other city to approve the standard used in a particular community. Community risk assessment and hazard analysis is a precursor to developing response time standards suited to the community's expectations for service and its financial ability to provide the necessary stations and resources.

In review of the AAFD documents, no such standards exist. There are several ways that a community can establish a response/travel time standard. Some of these are (1) the use of historical fire and EMS response data, (2) demand for service, (3) the level of care that the community wants

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[26] *GIS for Fire Stations Locations and Response Protocols*, An ESRI White Paper, January 2007, p. 8.

to provide, and (4) the level of care that the community is able to afford. In some cases, the analysis will assist in establishing the standard after a number of scenarios are examined.[27]

Recommendation #19: Develop response time standards for the community based on selected methodology(ies) approved by city elected officials.

2. EMS

The most prevalent form of medical transportation by fire departments is emergency-only service using multirole personnel (sworn, uniformed firefighters with EMS training and certifications). AAFD serves the community in a medical capacity as first responders only, supplying emergency medical interventions with personnel trained to the level of emergency medical technician.

Although some departments possess and maintain the higher level paramedic certification through their own resources, they do not and cannot act in this capacity without the express and written authorization of a licensed physician. The department has investigated the possibility of moving to provide this higher level of service; however, any further action toward establishing this higher level of service has not occurred.

Economically speaking, the emergency ambulance service compared to nonemergency (scheduled) transport service requires a high state of readiness, subjects vehicles to greater wear and tear, carries greater potential for civil liability, and involves a higher percentage of uncollectable fees for service. Very few private ambulance companies could survive if they

[27] Ibid.

limited their services to emergency transportation.[28] Whether or not a public fire department can compete with a private ambulance service on a cost-recovery basis depends on factors such as demographics of the community, the payer mix, the prevailing reimbursement rates, and the effectiveness of the billing and collection processes.

3. Fire Prevention Public Education

For each type of possible emergency, the building blocks of prevention are engineering, enforcement, education, and investigation.[29] *Engineering* deals with building appropriate fire protection components within a structure to minimize the risk of fire and other life safety issues. This must begin with state legislation and local ordinances. The role of *enforcement* is to ensure that laws (fire and life safety codes) are adhered to in various occupancy types within the community. *Education* is needed to affect the human behavior that cannot be enforced by established laws. Finally, *investigation* is needed to develop lessons that can be learned from fire and emergency incidents when these efforts, for whatever reason, somehow fail.

Fire departments have traditionally focused more resources on mitigating the effects of fires once started than on prevention. AAFD is minimally staffed in this regard, having only one full-time employee to handle the many responsibilities associated with this critical function.

Utilization of fire suppression personnel to supplement fire inspection personnel is a common practice among fire service organizations. However, firefighters are not trained directly in the finer points of fire and life safety codes, training that is needed to identify potential problems. Many communities are now hiring civilian fire safety inspectors to fill the void of

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[28] Dennis Compton and John Granito, editors, Managing Fire and Rescue Services (ICMA, 2002), p. 30.
[29] Ibid, p. 358.

career fire service inspectors. In addition to cost saving in salary and fringe and pension benefits, some see these positions as possible career ladders to becoming professionally certified firefighters and EMTs. Hiring preferences could serve as an incentive for those seeking career fire service opportunities. The state of Michigan permits municipal fire agencies to recover costs associated with fire prevention services. This is accomplished through various fee charges for fire prevention services. The City of Ann Arbor has already undertaken this initiative. With this initiative fully implemented, the financial impact of hiring civilian inspectors could be negated.

Although firefighters have not been trained in the finer points of fire safety inspection practices, a fire department may still reap many benefits from their involvement. Productivity among fire suppression personnel continues to decrease. EMS call volume within the AAFD, although much higher than fire runs, does not present a capacity problem (overwhelming number of simultaneous calls.) Properly trained fire suppression personnel can issue a first notice of violation, with supplemental follow-up by fire prevention staff trained at the higher level. This would call attention to a potentially serious problem before it has a chance to escalate into a possible fire situation.

Public education is yet another area where civilianization could aid in providing the needed human resources to reach the public with vital information from both the fire and life safety perspective. Miami-Dade Fire Rescue has for many years utilized civilians trained in both disciplines.

Recommendation #20: Consider hiring civilian employees for fire inspector and public education specialist positions.

Fire suppression personnel can also add considerable resources to combatting what has been identified through the ICMA data analysis as a significant fire problem within the city. Of 116 structure fires occurring in the city between the January 1, 2010 and December 31, 2010, 87 per cent were in residential structures. These fires accounted for two fire fatalities. This situation is not specific to Ann Arbor. From a national perspective, fires within residential structures have historically accounted for the majority of fire deaths and property loss. Within the survey period, total property loss in residential structures accounted for the lion’s share in dollar value, costing the community $1.24 million.

How can the department take advantage of lower productivity of its fire suppression personnel? One way is through implementation of planned public education and fire prevention programs aimed at addressing the residential fire problem. Smoke detectors have long proven effective in reducing deaths and property loss in residential structures. An active campaign providing free smoke detectors, including installation by firefighters, will go a long way toward bringing the issue under control.

The AAFD has in past attempted to distribute free smoke detectors, which proved unsuccessful. This may have been due to the fact that these smoke detectors had to be hard wired and presented a financial obligation on the part of the homeowner. However, battery operated smoke detectors have proven their reliability within the industry. As long as they are maintained with working batteries, they offer the homeowner good protection from fire-related incidents. Although money can be a limiting factor in providing a free program, it should not keep the department from investigating opportunities to secure grant funding, including donations from the business community, to implement such a worthwhile endeavor.

Recommendation #21: Develop a comprehensive smoke detector program, with an emphasis on residential structures.

Another area of public concern deals with the issue of reducing death caused by sudden cardiac arrest. Sixty-one million Americans have cardiovascular disease, resulting in approximately 1 million deaths per year. One third of these deaths (300,000-400,000) are due to cardiac arrest, the sudden and unexpected loss of heart function.

In November 1990, Dr. Roger White of the Mayo Clinic initiated a study to see if putting automated external defibrillators (AEDs) in City of Rochester police cars could help save the lives of victims of sudden cardiac arrest. The study proved conclusively that they did. The use of AEDs in City of Ann Arbor police vehicles should be implemented citywide, with AAFD serving in an administrative support capacity.

However, simply having these units available in police cars does not go far enough in helping to improve outcomes. A comprehensive program should be developed with fire department staff taking an administrative lead. Public access defibrillation (PAD) programs represent a more measured approach toward the achievement of efforts to reduce morbidity and mortality from cardiac arrest. These programs in place in various cities across the country are making a positive impact. In 1999, every police officer in Miami-Dade County was issued an AED and trained in its use. (Miami-Dade police officers have “take home” cars so each police car was outfitted with an AED, or approximately 2,500 units). The 9-1-1 dispatch system was adjusted so that both police and Miami-Dade Fire Rescue units would be dispatched to any medical call that was suspected of being a cardiac arrest event. If police arrive first, they carry out cardiopulmonary resuscitation and/or defibrillation until the arrival of fire-rescue. These kinds of medical partnerships between public safety personnel can significantly reduce response times in the most critical of medical emergencies.

In 1997, the City of Highland Park, Illinois, and the Park District of Highland Park placed AEDs in all city and park district buildings. In 2009, the Highland Park Fire Department applied for and was awarded a local grant in the amount of $38,000. In 2010, a second grant was approved for an additional $38,000. The grant funding allowed the city to place AEDs in businesses within the city and form a "network" of locations for bystanders to find an AED if it is needed. The program is called Heartstarter and looks to federal, state, and local sources as potential future funding possibilities.

Recommendation #22 Consider acquisition and placement of AEDs on all police vehicles. Develop comprehensive city-wide PAD program partnering with city parks and other departments to improve cardiac arrest outcomes.

4. Training

Training in the fire service is integral to maintaining an effective response force. Maintaining critical skills is necessary to ensure personnel are able to act effectively when the time arises.

The AAFD undertakes the responsibility for providing continual staff training with somewhat less efficiency and effectiveness than would be considered appropriate for a public safety agency. In a review of training calendars submitted by the department for the months of April, May, and June 2011, it was noted that an inordinate amount of time (1 p.m. to 5 p.m. each day) is devoted to what is blocked as "health and fitness (individual stations)." Although the wellness issue among firefighters is of concern, there are many areas requiring refresher training within the scope of firefighting and emergency medical response. Although training records submitted indicate the coverage of a wide array of topics, so much time spent in the area of "wellness and fitness" sends a bad message from a public relations standpoint.

The fact that so much time is given personnel in this area may be due to a lack of additional resources within the administrative staff to serve as training instructors. However, line officers should play a more active role in initiating training opportunities for their subordinates. The department training officer, although overwhelmed with individual training responsibilities, can provide guidance in this area to ensure an adequate level of training opportunities are provided among both line and staff personnel. Battalion commanders can also assume active roles in this regard. Other departments have developed packaged lesson plans or "canned training modules" developed by training officers with company officers as points of delivery to supplement the lack of administrative staff. AAFD must utilize all of its resources to improve and increase the amount of training received by its members.

Recommendation #23: Develop packaged lesson plans or "canned training modules" with a comprehensive training schedule for department personnel using line officers as points of delivery.

5. Communications

The city contracts with Huron Valley Ambulance (HVA) for communications and dispatch services. This agreement forms the basis for regionalization of and consolidation of communications services, something that would benefit the citizens of Ann Arbor as well as nine other area fire departments.

Although the contract calls for "continuous monitoring of performance measures to insure the volume and quality of service provided to the department," those measures are not clearly identified within the contract.

The contract appears to be more "level of effort" than that of a performance-based agreement. There should be identifiable measures of performance included in contract language. This is not the case and should be addressed. Another void within the contract is advisory committee participation involving all area partners. The importance of an ad hoc group providing oversight and recommendations for system-wide improvements cannot be overlooked.

Recommendation #24: Develop performance measures for HVA contract language.

Recommendation #25: Consider establishment of advisory committee comprised of representatives of area fire departments to serve in ad hoc capacity to monitor system performance and offer recommendations for improvement.

In addition to providing communications and dispatch services to the city of Ann Arbor, the HVA also supports the allied health care community with medical transport service at both the EMT and paramedic level. In a demand and response analysis conducted by the ICMA data team, observations of response times between AAFD and HVA show insignificant differences in arrival times among the various call types.

III. Data Analysis

The City of Ann Arbor’s Fire Department regularly staffs at least 18 full-time fighters on one heavy rescue unit, three engine units, one aerial platform, and one quint unit in five stations. In addition, the department has two reserve engine units and one hazardous material unit. The department regularly has a fire chief, three investigators, and three command officers on duty.

Our data analysis is divided into five sections. The first section focuses on call types and dispatches. The second section explores the workload of individual units. The third section presents response time analysis. The fourth section presents analysis of the busiest hours in a year. The fifth section compares response time of EMS calls responded to by both private ambulance and the city’s Fire Department.

The data in this report cover all service calls between March 1, 2010, and February28, 2011. During this period, Ann Arbor’s Fire Department received 6,697 fire and emergency medical service (EMS) calls and 19 canceled or mutual aid calls. A total of 8,305 Ann Arbor units were dispatched to calls during this period. This number is higher than the total number of calls because multiple units often respond to calls. The total combined yearly workload (also called deployed time or busy time) for all units was 2,393 hours. Last, the average total response time was 7.2 minutes for EMS category calls, 7.3 minutes for structure fire calls, and 8.3 minutes for outside fire calls. Please note that the data in the tables (e.g., percentages or daily average statistics) may not add up to expected totals due to rounding.

A. Aggregate Call Totals, Dispatches, and Deployed Time

During the year studied, the City of Ann Arbor Fire Department received 6,716 calls. There were 230 structure fire calls and 251 outside fire calls. We categorized a call as structure or outside fire call if the dispatch center or fire department database has recorded the call either as a structure or outside fire call. We categorized the rest of the calls based on the NFIRS call type code.

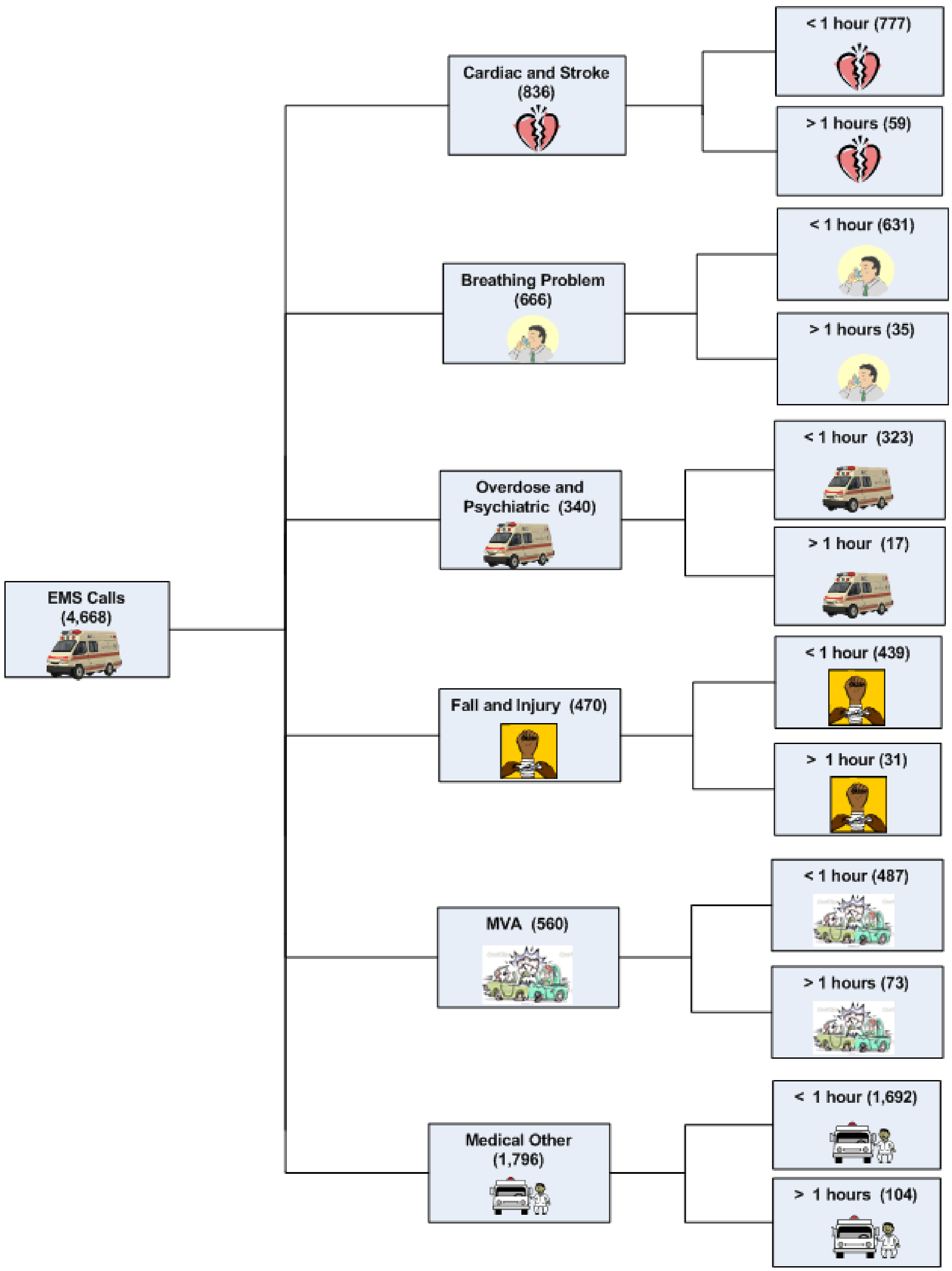
Table 7. Calls by Type

Call Type	Number of Calls	Calls per Day	Call Percentage
Cardiac and Stroke	836	2.3	12.4
Breathing Problem	666	1.8	9.9
Overdose and Psychiatric	340	0.9	5.1
Fall and Injury	470	1.3	7.0
MVA	560	1.5	8.3
Medical Other	1,796	4.9	26.7
EMS Total	**4,668**	**12.8**	**69.5**
Structure Fire	230	0.6	3.4
Outside Fire	251	0.7	3.7
Hazard	403	1.1	6.0
Alarm	966	2.6	14.4
Public Service	108	0.3	1.6
Investigation	71	0.2	1.1
Fire Total	**2,029**	**5.6**	**30.2**
Mutual Aid	9	0.0	0.1
Canceled	10	0.0	0.1
Total	**6,716**	**18.4**	**100.0**

Observations:

- The fire department responded to 6,716 calls, including nine mutual aid calls and 10 canceled calls, averaging 18.4 calls per day.
- EMS calls for the year totaled 4,668 (69.5 percent of all calls), or about 12.8 per day.
- Fire category calls for the year totaled 2,029 (30.2 percent of all calls), or about 5.6 per day.
- Structure and outside fire calls combined for the year totaled 481, or about 1.3 calls per day.

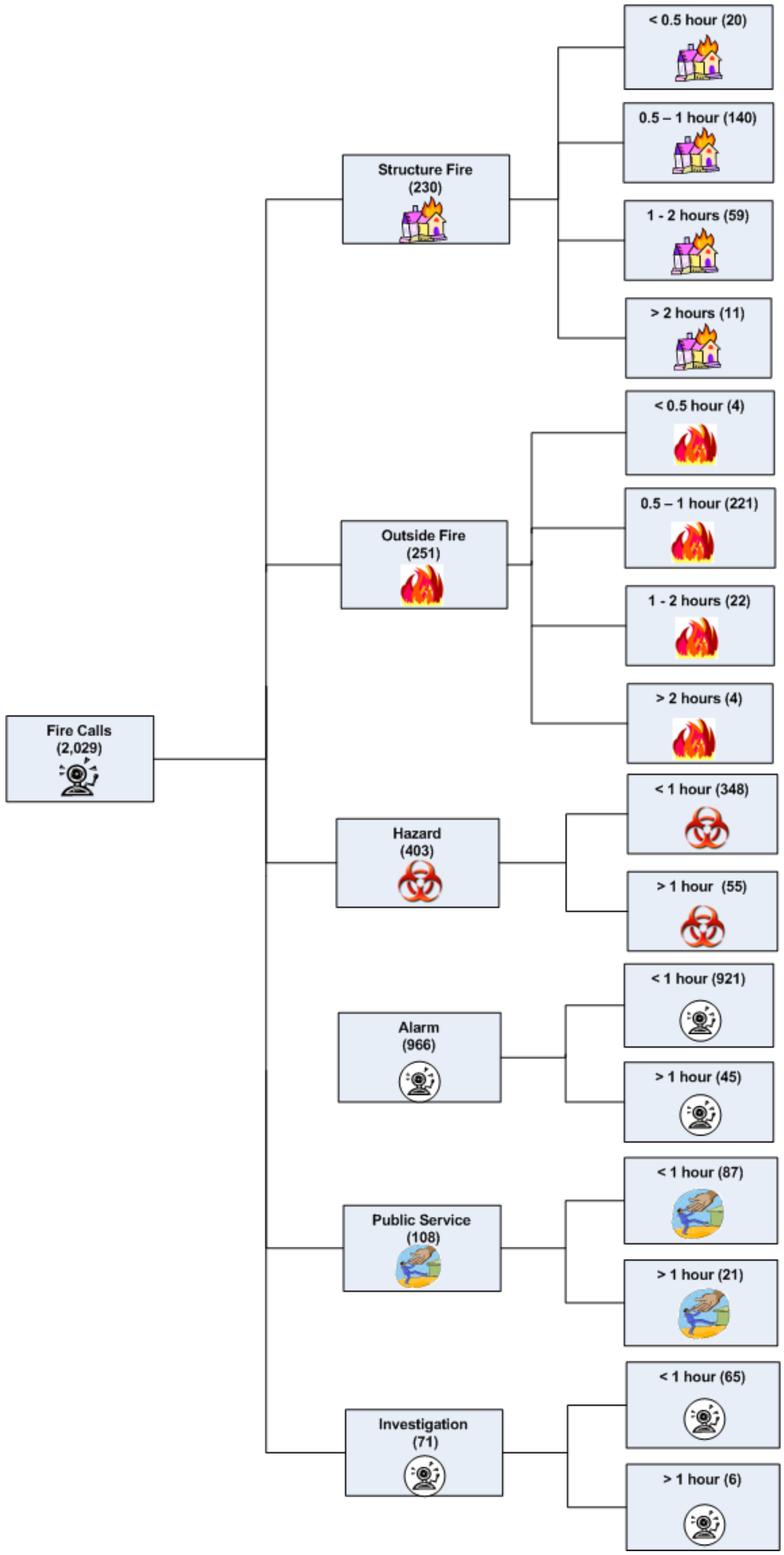
Figure 10. EMS Calls by Type and Duration



Observations:

- A total of 4,349 EMS calls (93.2 percent) lasted less than one hour; 314 EMS calls (6.7 percent) lasted between one and two hours; and five EMS calls (0.1 percent) lasted more than two hours. On average, slightly less than one EMS category call per day lasted more than an hour.

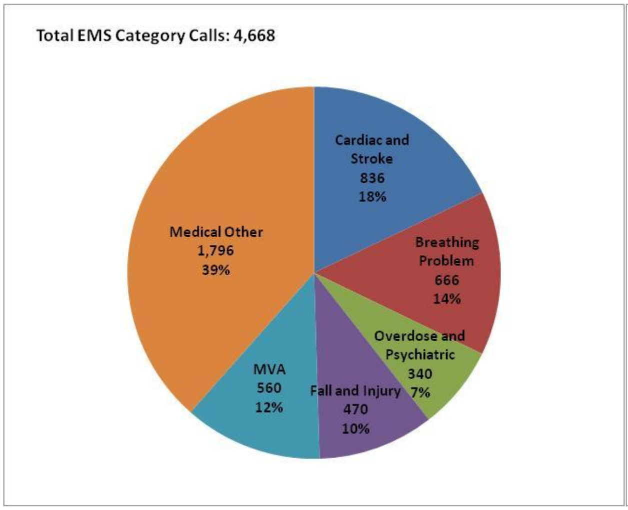
Figure 11. Fire Calls by Type and Duration

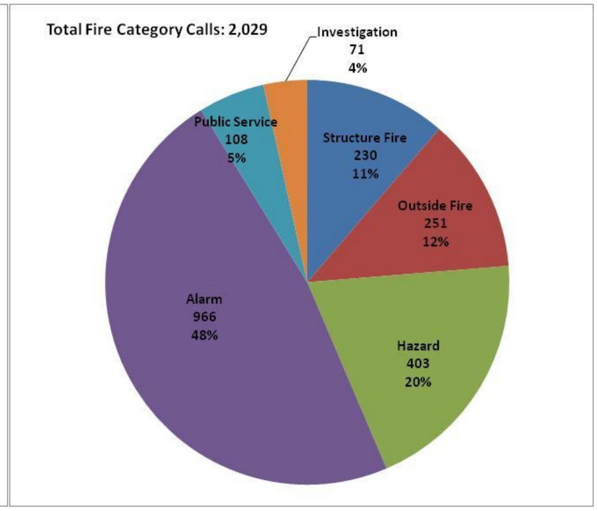


Observations:

- A total of 1,806 fire category calls (89.0 percent) lasted less than one hour; 192 fire category calls (9.5 percent) lasted between one and two hours; and 31 fire category calls (1.5 percent) lasted more than two hours. On average, there were 4.3 fire category calls per week that lasted more than an hour.
- Of the 230 structure fire calls, 160calls (69.6 percent) lasted less than one hour; 59calls lasted between one and two hours (25.7 percent); and 11calls (4.8 percent) lasted more than two hours.
- Of the 251outside fire calls during the year, 225 calls (89.6 percent) lasted less than one hour; 22 calls (8.8 percent) lasted between one and two hours; and four calls (1.6 percent) lasted more than two hours.

Figure 12. EMS and Fire Calls by Type

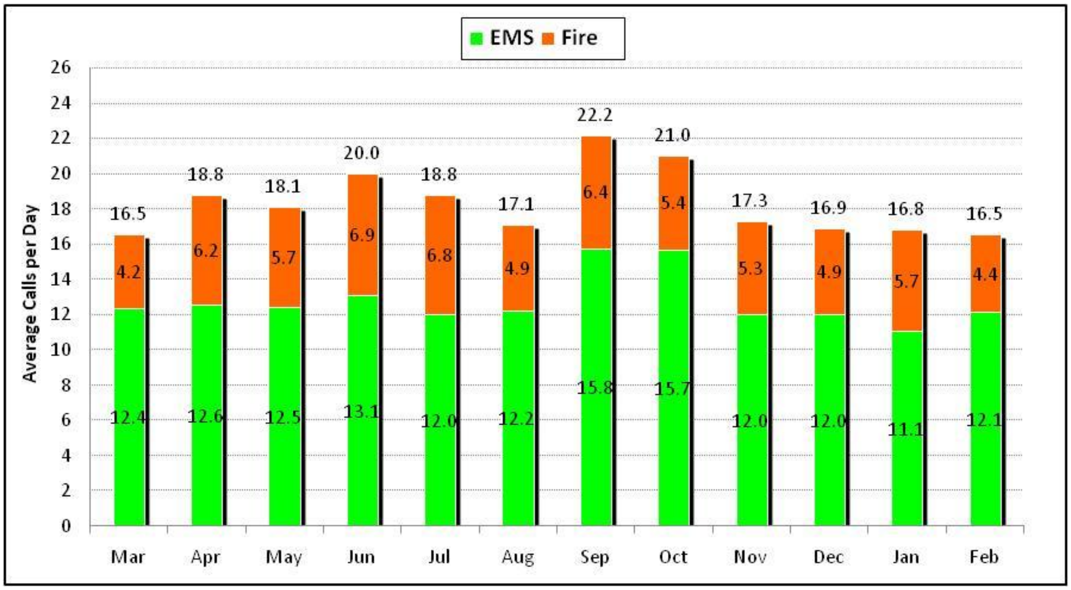




Observations:

- A total of 481 structure fire and outside fire calls accounted for 23 percent of the fire category total.
- Alarm calls accounted for48 percent of the fire category calls.
- Hazardous condition calls accounted for20 percent of the fire category total.
- Public service calls accounted for5 percent of the fire category total.
- Investigation calls accounted for4 percent of the fire category total.
- A total of 836 cardiac and stroke calls accounted for 18 percent of the EMS category total.
- Breathing problems calls accounted for14 percent of the EMS category total.
- Overdose and psychiatric calls accounted for 7 percent of the EMS category total.
- Fall and injury calls accounted for 10 percent of the EMS category total.
- MVA calls accounted for12 percent of the EMS category total.
- Medical other calls accounted for39 percent of the EMS category total.

Figure 13. Average Calls per Day by Month



Observations:

- Average calls per day ranged from a low of 16.5 calls per day in March 2010 and February 2011 to a high of22.2 calls per day in September 2010. The highest monthly average was 35 percent greater than the lowest monthly average.
- Average EMS calls per day varied from a low of 11.1 calls per day in January 2011 to a high of 15.8 calls per day in September 2010.
- Average fire category calls per day varied from a low of 4.2 calls per day in March 2010 to a high of 6.9 calls per day in June 2010.
- The city held a summer festival between June 18 and July 11 and an art fair between July 21 and 24. During these periods, the fire department received the most calls on June 18, totaling 40 calls that day.
- On October 9, 2010, Ann Arbor had a football game and received 66 calls in a day, 62 of which were EMS calls.

Figure 14. Calls by Hour of Day

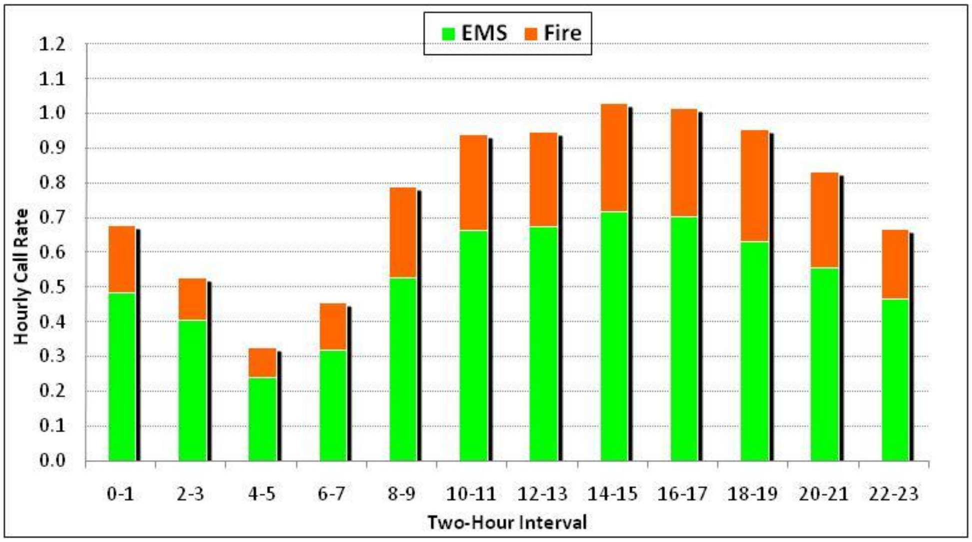


Table 8. Calls by Hour of Day

Two-Hour Interval	Hourly Call Rate		
	EMS	Fire	Total
0-1	0.48	0.20	0.68
2-3	0.41	0.12	0.53
4-5	0.24	0.09	0.33
6-7	0.32	0.14	0.46
8-9	0.53	0.26	0.79
10-11	0.66	0.28	0.94
12-13	0.68	0.27	0.95
14-15	0.72	0.31	1.03
16-17	0.70	0.31	1.02
18-19	0.63	0.32	0.95
20-21	0.56	0.28	0.83
22-23	0.47	0.20	0.67
Calls per Day	**12.79**	**5.56**	**18.35**

Note: Average calls per day shown are the sum of each row multiplied by two, since each row represents two hours.

Observations:

- Hourly call rates were highest between 10 a.m. and 8 p.m., averaging between 0.94 and 1.03calls per hour.
- Call rates were lowest between 2 a.m. and 8 a.m., averaging fewer than 0.53 calls per hour.

Figure 15. Number of Units Dispatched to Calls

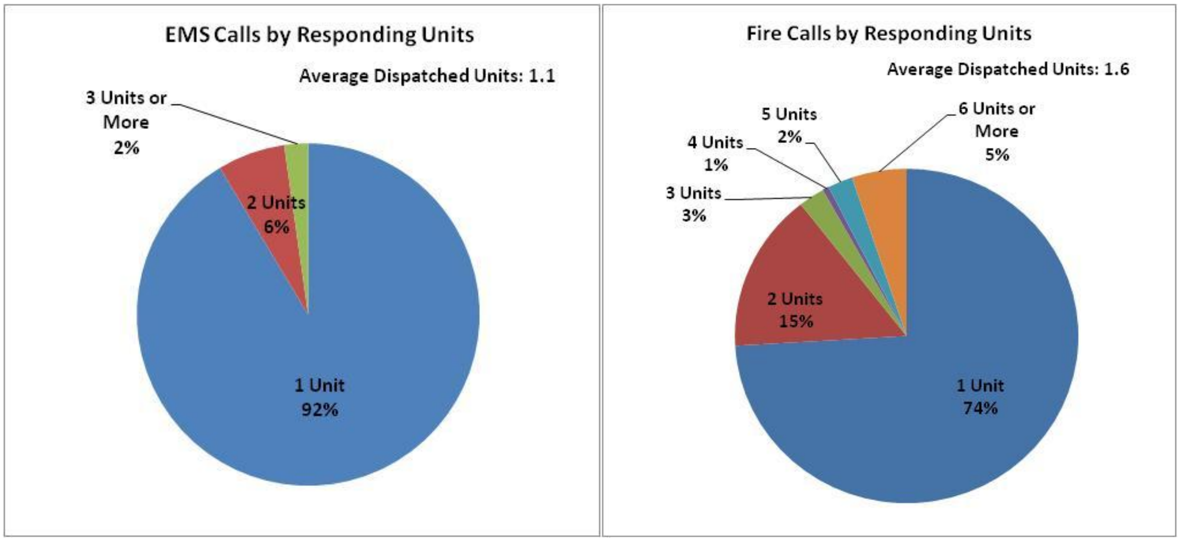


Table 9. Number of Units Dispatched to Calls

Call Type	Unit						Total
	One	Two	Three	Four	Five	Six or More	
Cardiac and Stroke	788	44	2		1	1	836
Breathing Problem	633	31	2				666
Overdose and Psychiatric	325	13	2				340
Fall and Injury	436	28	5	1			470
MVA	405	76	13	44	18	4	560
Medical Other	1,679	105	10	1	1		1,796
EMS Total	**4,266**	**297**	**34**	**46**	**20**	**5**	**4,668**
Structure Fire	25	50	13	3	41	98	230
Outside Fire	164	59	16	8	1	3	251
Hazard	270	110	14	1	4	4	403
Alarm	892	69	4		1		966
Public Service	89	16	2		1		108
Investigation	63	7	1				71
Fire Total	**1,503**	**311**	**50**	**12**	**48**	**105**	**2,029**
Grand Total	**5,769**	**608**	**84**	**58**	**68**	**110**	**6,697**
Percentage	**86.1**	**9.1**	**1.3**	**0.9**	**1.0**	**1.6**	**100**

Observations:

- The department regularly staffs one heavy rescue unit, three engine units, one aerial platform, and one quint unit in three stations.
- Overall, three or more units were dispatched to 4.8 percent of calls.
- On average, 1.1 units were dispatched per EMS call.
- For EMS calls, one unit was dispatched 91.4 percent of the time, two units were dispatched 6.4 percent of the time, and three or more units were dispatched 2.2 percent of the time.
- On average, 1.6 units were dispatched per fire category call.
- For fire category calls, one unit was dispatched 74.1 percent of the time, two units were dispatched 15.3 percent of the time, three units were dispatched 2.5 percent of the time, and four or more units were dispatched 8.1 percent of the time.
- For structure fire calls, one unit was dispatched 10.9 percent of the time, two units were dispatched 21.7 percent of the time, three units were dispatched 5.7 percent of the time, four units were dispatched 1.3 percent of the time, five units were dispatched 17.8 percent of the time and six or more units were dispatched 42.6 percent of the time.
- For outside fire calls, one unit was dispatched 65.3 percent of the time, two units were dispatched 23.5 percent of the time, and three or more units were dispatched 11.2 percent of the time.

Table 10. Annual Deployed Time by Call Type

Call Type	Average Busy Minutes per Run	Annual Busy Hours	Percent of Busy Hours	Busy Minutes per Day	Number of Runs	Runs per Day
Cardiac and Stroke	16.3	242	9.8	40	890	2.4
Breathing Problem	15.9	186	7.5	31	701	1.9
Overdose and Psychiatric	14.3	85	3.5	14	357	1.0
Fall and Injury	15.6	133	5.4	22	511	1.4
MVA	16.4	224	9.1	37	818	2.2
Medical Other	14.9	477	19.3	78	1,924	5.3
EMS Total	**15.5**	**1,347**	**54.5**	**221**	**5,201**	**14.2**
Structure Fire	26.5	395	16.0	65	894	2.4
Outside Fire	16.7	103	4.2	17	368	1.0
Hazard	24.2	230	9.3	38	572	1.6
Alarm	13.9	242	9.8	40	1,043	2.9
Public Service	20.5	44	1.8	7	128	0.4
Investigation	17.7	23	0.9	4	79	0.2
Fire Total	**20.2**	**1,037**	**42.0**	**170**	**3,084**	**8.4**
Mutual Aid	47.7	8	0.3	1	10	0.0
Canceled	12.3	2	0.1	0	10	0.0
Total	**17.3**	**2,393**	**96.9**	**393**	**8,305**	**22.8**

Observations:

- Total deployed time for the year, or total busy hours, was 2,393 hours.
- There were a total of 8,305 runs, averaging 22.8 runs per day.
- Fire category calls accounted for 37.1 percent of the total workload.
- There were a total of 1,262 runs for structure and outside fire calls, with a total workload of 498 hours. This accounted for 15.2 percent of the total workload. The average busy time for structure fire calls was 26.5 minutes, and the average busy time for outside fire calls was 16.7 minutes.
- EMS calls accounted for 62.6 percent of the total workload. The average busy time for EMS calls was 15.5 minutes.

B. Workload by Individual Unit— Calls and Total Time Spent

In this section we look at the actual time spent by each unit on every call. We report two types of statistics: workload and runs. Canceled and mutual aid calls are not included. After the introductory table, we present run data and workload data for every unit, as well as the daily average for the engine, quint, ladder truck, and rescue units.

Table 11. Call Workload by Unit and Station

Station	Unit Type	Unit ID	Average Busy Minutes per Run	Number of Runs	Runs per Day	Busy Minutes per Day	Annual Busy Hours
1	Pumper	E11	20.2	186	0.5	10.3	62.8
	Heavy Rescue	R11	14.5	2,302	6.3	91.6	557.1
	Aerial Platform	TW11	17.1	1,033	2.8	48.4	294.2
3	Pumper	E13	19.0	1,073	2.9	55.9	339.8
4	Pumper	E14	17.0	1,232	3.4	57	345.0
5	Pumper	E15	16.9	104	0.3	4.8	29.3
	Quint	L15	21.6	1,009	2.8	59.6	362.4
6	Pumper	E16	16.7	1,350	3.7	61.8	376.0
	Haz-Mat	HZ1	99.4	15	0.0	4.1	24.8

Note: Engine units E11 and E15 and hazardous material unit HZ1 were not regularly staffed and were staffed only when needed. Mechanic unit, MECH, was dispatched only once in the study year.

Observations:

- Engine E11 is not regularly staffed and made 186 runs and was busy for 62.8 hours in a year.
- Heavy Rescue unitR11 made 2,302 runs, averaging 6.3 runs and one hour, 31.6 minutes of busy time per day.
- Aerial platform TW11 made 1,033 runs, averaging 2.8 runs and 48.4 minutes of busy time per day.
- Engine E13 made 1,073 runs, averaging 2.9 runs and 55.9 minutes of busy time per day.
- Engine E14 made 1,232 runs, averaging 3.4 runs and 57.0 minutes of busy time per day.
- Engine E15is not regularly staffed and made 104 runs and was busy for 29.3 hours in a year.
- QuintL15 made 1,009 runs, averaging 2.8 runs and 59.6 minutes of busy time per day.
- Engine E16 made 1,350 runs, averaging 3.7 runs and one hour and 1.8 minutes of busy time per day.
- Hazardous material unit HZ1is not regularly staffed and made 15 runs and was busy 24.8 hours in a year.

Figure 16. Busy Minutes by Hour of Day

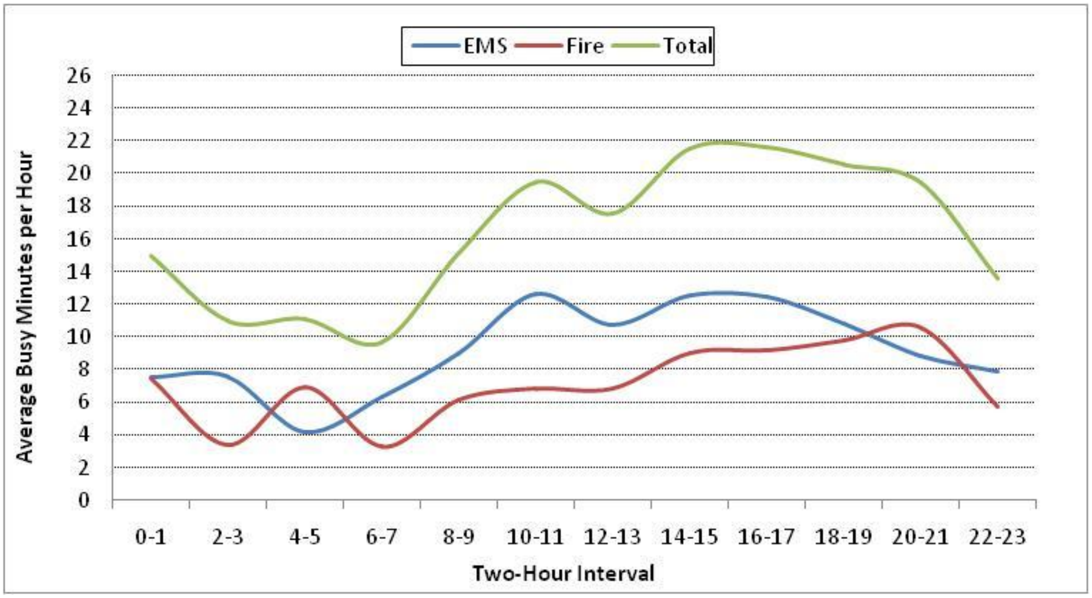


Table 12. Busy Minutes by Hour of Day

Two-Hour Interval	EMS	Fire	Total
0-1	7.5	7.4	15.0
2-3	7.6	3.4	11.0
4-5	4.2	6.9	11.1
6-7	6.4	3.3	9.7
8-9	9.0	6.1	15.2
10-11	12.7	6.8	19.5
12-13	10.7	6.8	17.6
14-15	12.6	9.0	21.6
16-17	12.5	9.2	21.7
18-19	10.8	9.8	20.6
20-21	8.9	10.6	19.5
22-23	7.9	5.7	13.6
Daily Total	221.4	170.4	391.7

Note: Daily totals shown equal the sum of each row multiplied by two, since each row represents two hours.

Observations:

- Hourly busy minutes were the highest between 10 a.m. and 10 p.m., averaging between 17.6 and 21.7 minutes per hour.
- Hourly busy minutes were the lowest between 2 a.m. and 8 a.m., averaging fewer than 11.1 minutes per hour.

Table 13. Fire Units: Annual Total and Daily Average Number of Runs by Call Type

Unit	EMS	**Structure Fire**	**Outside Fire**	Hazard	Alarm	Public Service	Investigation	**Total**	**Runs per Day**
E11	57	**33**	**2**	28	64	1	1	**186**	**0.5**
E13	749	**123**	**49**	60	64	22	5	**1,072**	**2.9**
E14	780	**148**	**66**	72	131	17	15	**1,229**	**3.4**
E15	59	**11**	**6**	10	15		2	**103**	**0.3**
E16	872	**149**	**65**	67	171	15	8	**1,347**	**3.7**
L15	631	**113**	**41**	55	131	18	17	**1,006**	**2.8**
TW11	222	**153**	**63**	148	412	15	16	**1,029**	**2.8**
HZ1	3	**1**		11				**15**	**0.0**

Note: MECH was not included in this table.

Observations:

- Engines E11 and E15 were not regularly staffed and made 186 and 103 runs respectively in a year.
- E13 made 1,072 runs during the year, averaging 2.9 runs per day. It was dispatched to calls involving actual fires172 times during the year.
- E14 made 1,229 runs during the year, averaging 3.4 runs per day. It was dispatched to calls involving actual fires214 times during the year.
- E16 made 1,347 runs during the year, averaging 3.7 runs per day. It was dispatched to calls involving actual fires214 times during the year.
- L15 made 1,006 runs during the year, averaging 2.8 runs per day. It was dispatched to calls involving actual fires154 times during the year.
- TW11 made 1,029 runs during the year, averaging 2.8 runs per day. It was dispatched to calls involving actual fires216 times during the year.

Table 14. Fire Units: Daily Average Deployed Minutes by Call Type

Unit	EMS	**Structure Fire**	**Outside Fire**	Hazard	Alarm	Public Service	Investigation	**Total**	**Fire Category Calls Percentage**
E11	2.2	**3.9**	**0.1**	1.9	2.2	0.0	0.1	**10.3**	**78.6**
E13	36.2	**8.2**	**2.4**	4.6	2.9	1.4	0.3	**55.8**	**35.1**
E14	32.1	**11.0**	**3.0**	4.1	4.7	0.9	0.4	**56.1**	**42.8**
E15	2.9	**0.9**	**0.2**	0.4	0.5		0.1	**4.8**	**39.6**
E16	36.7	**9.3**	**3.2**	3.8	7.0	1.2	0.4	**61.6**	**40.4**
L15	36.1	**8.6**	**1.9**	4.6	5.9	0.9	1.3	**59.3**	**39.1**
TW11	8.1	**12.0**	**2.7**	9.0	14.3	1.2	0.8	**48.1**	**83.2**
HZ1	1.0	0.0		3.0				**4.1**	**75.6**

Note: The percentage of time spent on fire category calls is the sum of average deployed minutes per day of all non-EMS calls divided by the total deployed minutes per day.

Observations:

- E11, E15 and HZ1 were not regularly staffed and were busy less than 10.3 minutes per day.
- On average, engine E13 was busy 55.8 minutes per day. Fire category calls accounted for 35.1 percent of its daily workload.
- On average, engine E14 was busy 56.1 minutes per day. Fire category calls accounted for 42.8 percent of its daily workload.
- On average, engine E16 was busy 61.6 minutes per day. Fire category calls accounted for 40.4 percent of its daily workload.
- On average, L15 was busy 59.3 minutes per day. Fire category calls accounted for 39.1 percent of its daily workload.
- On average, TW11 was busy 48.1 minutes per day. Fire category calls accounted for 83.2 percent of its daily workload.

Table 15. Fire Units: Annual Busy Time by Number of Busy Units

Number of Busy Units	Annual Minutes	Annual Hours	Percent of Time
Zero	443,065	7,384	84.3
One	66,514	1,109	12.7
Two	10,265	171	2.0
Three	2,598	43	0.5
Four	1,266	21	0.2
Five	1,702	28	0.3
Six	126	2	0.0
Seven	64	1	0.0
Total	525,600	8,760	100.0

Observations:

- Eighty-four percent of the time, no units were deployed at calls.
- On average, two or more fire units (engine, quint, hazardous material, and/or aerial platform) were involved simultaneously at calls for 43.9 minutes per day.
- On average, three or more fire units were involved simultaneously at calls for 15.8 minutes per day.

Table 16. Rescue Unit: Annual Total and Daily Average Number of Runs by Call Type

Unit	C.S.	B.P.	O.P.	F.I	MVA	Medical Other	Structure and Outside Fire	Fire Other	**Total**	**Runs per Day**
R11	245	171	207	180	245	780	238	231	**2,297**	**6.3**

Note: C.S.: Cardiac and Stroke; B.P.: Breathing Problem; O.P.:Overdose and Psychiatric; F.I.: Fall and Injury.

Observations:

- Heavy rescue unit R11 made 2,297 runs in a year, averaging 6.3 runs per day. It was dispatched 238 times to structure and outside fire calls.

Table 17. Rescue Unit: Daily Average Deployed Minutes by Call Type

Unit	C.S.	B.P.	O.P.	F.I.	MVA	Medical Other	Structure and Outside Fire	Fire Other	**Total**	**EMS Calls Percentage**
R11	9.5	6.2	7.3	6.9	9.4	27.0	14.1	10.7	**91.2**	**72.8**

Note: C.S.: Cardiac and Stroke; D.B.: Difficulty Breathing; O.P.:Overdose and Psychiatric; F.I.: Fall and Injury.

Observations:

- On average, heavy rescue unit R11 was busy for one hour and 31.2 minutes per day. EMS calls accounted for 72.8 percent of its daily workload.

C. Dispatch Time and Response Time

In this section we present dispatch and response time statistics for different call types and units. We are interested mainly in the dispatch time and response time of the first arriving units. For structure and outside fire calls, we analyze the response time of the first and second arriving fire vehicles (no rescue unit).

We use different terms to describe the components of response time.

- *Dispatch processing time* is the difference between the call receipt time at the dispatch center and the unit dispatch time.
- *Turnout time* is the difference between the unit dispatch time and the unit time en route.
- *Travel time* is the difference between the unit time en route and the unit on-scene arrival time.
- *Response time* is the difference between the call receipt time and the unit on-scene arrival time.

During the study period (March 1, 2010, to February 28, 2011), the average dispatch time was 1.7 minutes, the average turnout time was 2.1 minutes, and the average travel time was 3.7 minutes. The average response time for EMS calls was 7.2 minutes, and the average response time for structure and outside fire calls was 7.3 and 8.3 minutes respectively.

Table 18. Average Dispatch, Turnout, Travel, and Response Time and 90th Percentile Response Time of First Arriving Unit by Call Type

Call Type	Dispatch Time	Turnout Time	Travel Time	Response Time	90th Percentile Response Time	Sample Size
Cardiac and Stroke	1.2	2.0	3.5	6.7	9.6	748
Breathing Problem	1.1	2.2	3.5	6.8	9.7	594
Overdose and Psychiatric	2.0	2.4	3.6	8.0	12.3	285
Fall and Injury	3.1	2.2	3.6	8.9	17.3	394
MVA	1.6	1.9	3.6	7.1	11.0	410
Medical Other	1.6	2.2	3.2	7.0	10.2	1,532
EMS Total	**1.7**	**2.1**	**3.4**	**7.2**	**10.4**	**3,963**
Structure Fire	1.7	2.4	3.2	7.3	9.6	215
Outside Fire	1.5	2.2	4.6	8.3	12.7	206
Hazard	2.8	2.3	5.5	10.6	15.9	345
Alarm	1.4	2.2	3.9	7.5	10.7	716
Public Service	2.4	2.1	4.9	9.4	15.2	75
Investigation	2.1	2.4	4.4	8.9	10.3	53
Fire Total	**1.8**	**2.3**	**4.3**	**8.4**	**12.3**	**1,610**
Total	**1.7**	**2.1**	**3.7**	**7.5**	**11.0**	**5,573**

Figure 17. Average Dispatch, Turnout, and Travel Time of First Arriving Unit by EMS Call Type

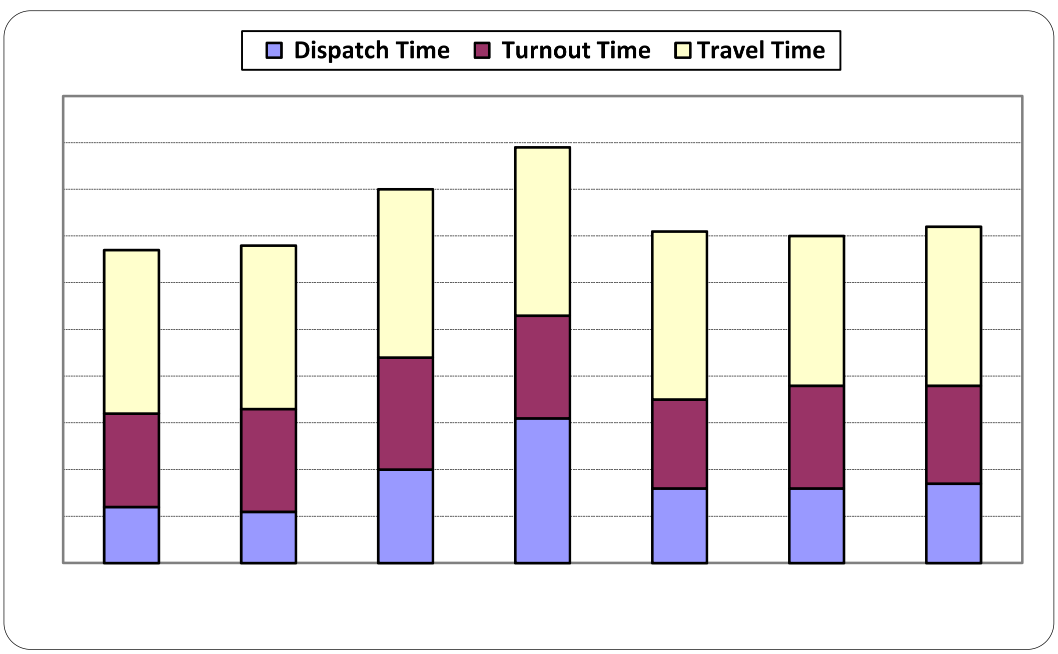
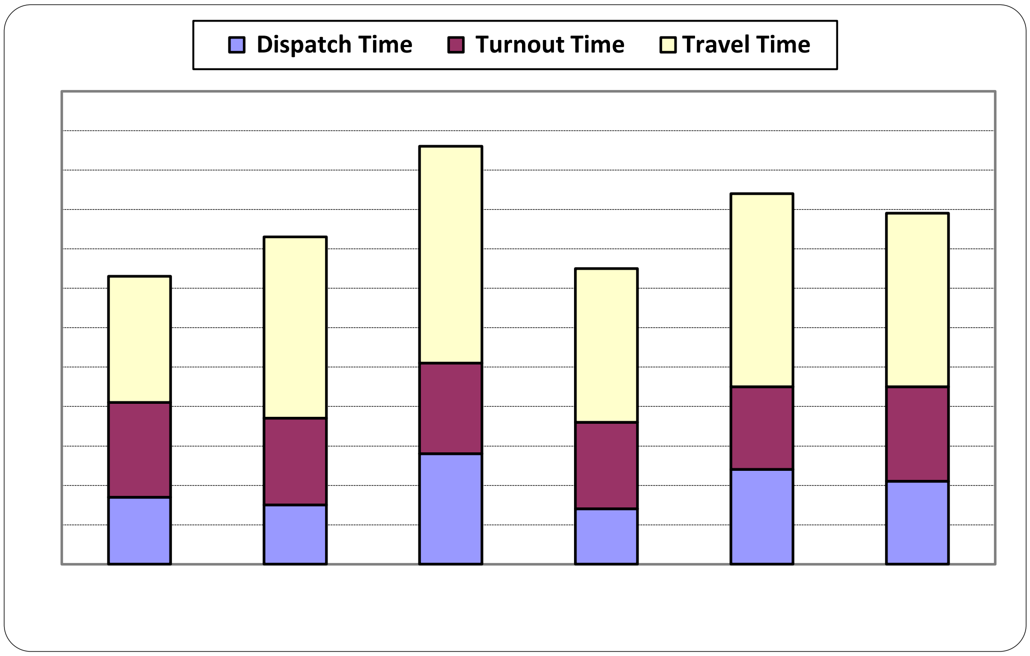


Figure 18. Average Dispatch, Turnout, and Travel Time of First Arriving Unit by Fire Call Type



Observations:

- The average dispatch time was 1.7 minutes.
- The average turnout time was 2.1 minutes.
- The average travel time was 3.7 minutes.
- The average response time for EMS category calls was 7.2 minutes and the 90th percentile response time was 10.4 minutes.
- The average response time for fire category calls was 8.4 minutes and the 90th percentile response time was 12.3 minutes.
- The average response times for structure fire and outside fire calls were 7.3 and 8.3 minutes, respectively.

Figure 19. Average Dispatch, Turnout, Travel, and Response Time of First Arriving Unit by Hour of Day

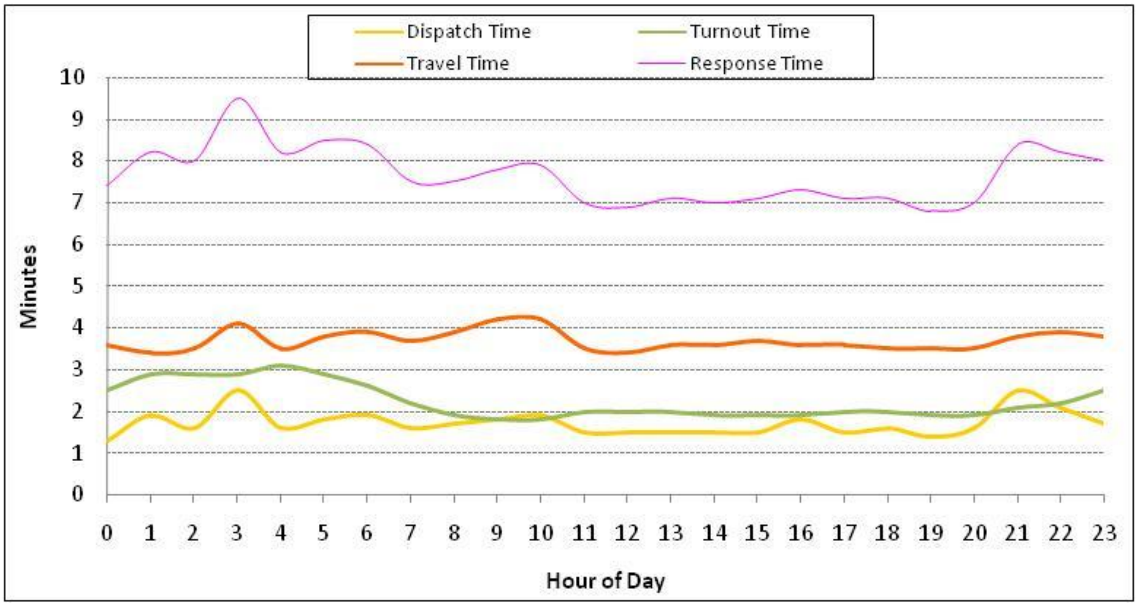


Table 19. Average Dispatch, Turnout, Travel, and Response Time of First Arriving Unit by Hour of Day

Hour	Dispatch Time	Turnout Time	Travel Time	Response Time	Sample Size
0	1.3	2.5	3.6	7.4	196
1	1.9	2.9	3.4	8.2	229
2	1.6	2.9	3.5	8.0	171
3	2.5	2.9	4.1	9.5	148
4	1.6	3.1	3.5	8.2	108
5	1.8	2.9	3.8	8.5	101
6	1.9	2.6	3.9	8.4	129
7	1.6	2.2	3.7	7.5	154
8	1.7	1.9	3.9	7.5	213
9	1.8	1.8	4.2	7.8	249
10	1.9	1.8	4.2	7.9	272
11	1.5	2.0	3.5	7.0	288
12	1.5	2.0	3.4	6.9	273
13	1.5	2.0	3.6	7.1	297
14	1.5	1.9	3.6	7.0	323
15	1.5	1.9	3.7	7.1	296
16	1.8	1.9	3.6	7.3	311
17	1.5	2.0	3.6	7.1	303
18	1.6	2.0	3.5	7.1	303
19	1.4	1.9	3.5	6.8	291
20	1.6	1.9	3.5	7.0	252
21	2.5	2.1	3.8	8.4	265
22	2.1	2.2	3.9	8.2	207
23	1.7	2.5	3.8	8.0	194
Total	1.7	2.1	3.7	7.5	5,573

Observations:

- Average dispatch time was between 1.3 and 2.5 minutes. Between 3 a.m. and 4 a.m. and between 9 p.m. and 10 p.m., it averaged 2.5 minutes.
- Average turnout time was between 1.8 and 3.1 minutes. The average turnout time between 1 a.m. and 6 a.m. was longer than 2.9 minutes.
- Average travel time was between 3.4 and 4.2 minutes.
- Average response time was between 6.8 and 9.5 minutes. Between 1 a.m. and 6 a.m., the average response time was longer than 8.0 minutes.

Figure 20. Number of Total Calls by First Arriving Unit

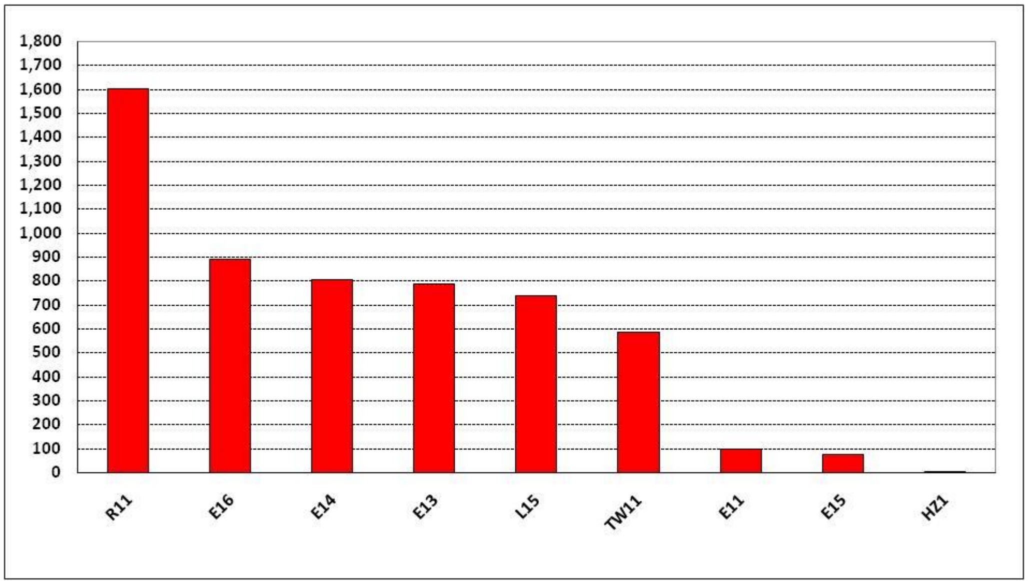


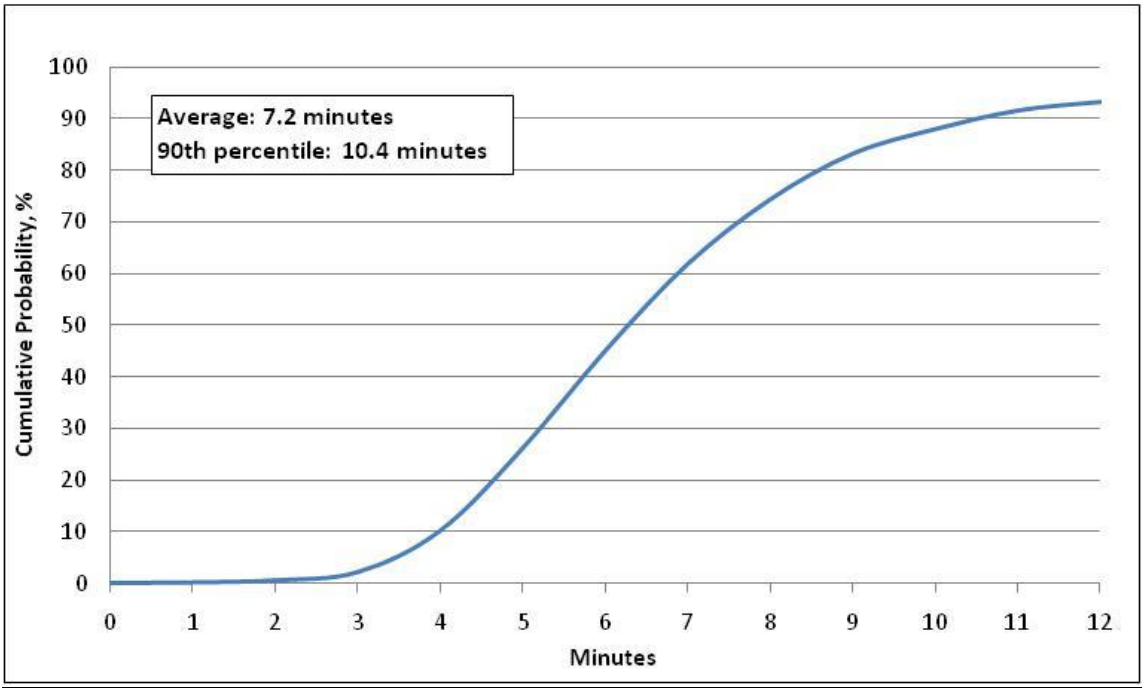
Table 20. Number of Total Calls by First Arriving Unit

Unit	EMS	Structure and Outside Fire	Fire Other	Total	Percentage	Cumulative Percentage
R11	1,393	90	120	1,603	28.8	28.8
E16	636	70	182	888	15.9	44.7
E14	572	72	158	802	14.4	59.1
E13	612	58	114	784	14.1	73.2
L15	542	47	148	737	13.2	86.4
TW11	127	64	395	586	10.5	96.9
E11	31	11	54	96	1.7	98.6
E15	48	9	16	73	1.3	99.9
HZ1	2		2	4	0.1	100.0

Observations:

- Heavy rescue unit R11 arrived first on scene most often, followed by engine units E16 and E14. The top three first arriving units accounted for 59.1 percent of the first arrivals at calls.
- For structure and outside fire calls, the top three first arriving units (R11, E14, and E16) accounted for 55.1 percent of the first arrivals at calls.

Figure 21. Cumulative Distribution Function (CDF) of Response Time of First Arriving Unit for EMS Calls



<u>Reading the CDF Chart</u>

The vertical axis is the probability or percentage of calls. The horizontal axis is response time. For example, with regard to EMS calls, the 90 percent probability line intersects the graph at about 10.4 minutes. This means that units responded in less than 10.4 minutes for 90 percent of EMS calls.

Table 21. Cumulative Distribution Function of Response Time of First Arriving Unit for EMS Calls

Response Time	Frequency	Cumulative Percentage
0 - 1 min.	6	0.2
1 - 2 min.	16	0.6
2 - 3 min.	63	2.1
3 - 4 min.	318	10.2
4 - 5 min.	633	26.1
5 - 6 min.	748	45.0
6 - 7 min.	667	61.8
7 - 8 min.	496	74.4
8 - 9 min.	352	83.2
9 - 10 min.	189	88.0
10 -11 min.	143	91.6
11 - 12 min.	66	93.3
12 - 13 min.	39	94.3
13 - 14 min.	30	95.0
14 - 15 min.	25	95.7
> 15 min.	172	100.0

Observations:

- The average response time for EMS calls was 7.2 minutes.
- For 90 percent of EMS calls, the response time was less than 10.4 minutes.

Response Time Analysis for Structure and Outside Fire Calls

The following tables and charts report response time analysis of first arriving fire units for structure and outside fire calls. The analysis includes engine, quint, hazardous material, and/or aerial platform units. The response time analysis does *not* include the heavy rescue unit dispatched for structure and outside fire calls, since this unit typically arrives along with the engine company based in its station.

Table 22. Average Response Time for Structure Fire and Outside Fire Calls by First Arriving Fire Unit

First Arriving Unit	Outside Fire		Structure Fire		Total	
	Response Time	Number of Calls	Response Time	Number of Calls	Response Time	Number of Calls
E11	7.9	2	6.2	12	6.4	14
E13	9.6	30	7.3	31	8.4	61
E14	7.8	36	8.1	40	8.0	76
E15	8.5	5	6.8	5	7.7	10
E16	8.7	34	6.9	41	7.7	75
L15	9.5	23	7.3	26	8.4	49
TW11	8.2	40	7.9	57	8.0	97

Observations:

- A total of 33 outside fire calls had were responded to only by heavy rescue unit R11. For calls with at least one fire unit dispatched, 48 outside fire and 18 structure fire calls had no valid unit on-scene arrival time to report response time.
- For structure fire calls, aerial platform TW11 was the first fire unit on scene most often and had an average response time of 7.9 minutes. Engine unit E11 had the shortest average response time of 6.2 minutes.
- For outside fire calls, aerial platform TW11 was the first fire unit on scene most often and had an average response time of 8.2 minutes.

Engine unit E14 had the shortest average response time of 7.8 minutes.

- On average, the response time of the first arriving fire unit for structure and outside fire calls was 8.0 minutes.

Table 23. Average Response Time for Structure Fire and Outside Fire Calls by Second Arriving Fire Unit

Second Arriving Unit	Outside Fire		Structure Fire		Total	
	Response Time	Number of Calls	Response Time	Number of Calls	Response Time	Number of Calls
E11			8.0	6	8.0	6
E13	8.2	4	8.0	24	8.0	28
E14	11.0	5	10.9	33	10.9	38
E16	11.3	7	8.9	22	9.5	29
L15	14.1	1	10.1	13	10.4	14
TW11	9.0	3	9.4	33	9.4	36

Observations:

- For structure fire calls, aerial platform TW11 and engine unit E14 were the second unit on scene most often and had an average response time of 9.4 and 10.9 minutes, respectively.
- For outside fire calls, engine unit E16 was the second unit on scene most often and had an average response time of 11.3 minutes.
- On average, the response time of the second arriving fire unit for structure and outside fire calls was 9.6 minutes.

Figure 22. Cumulative Distribution Function of Response Time of First and Second Arriving Fire Unit for Structure Fire Calls

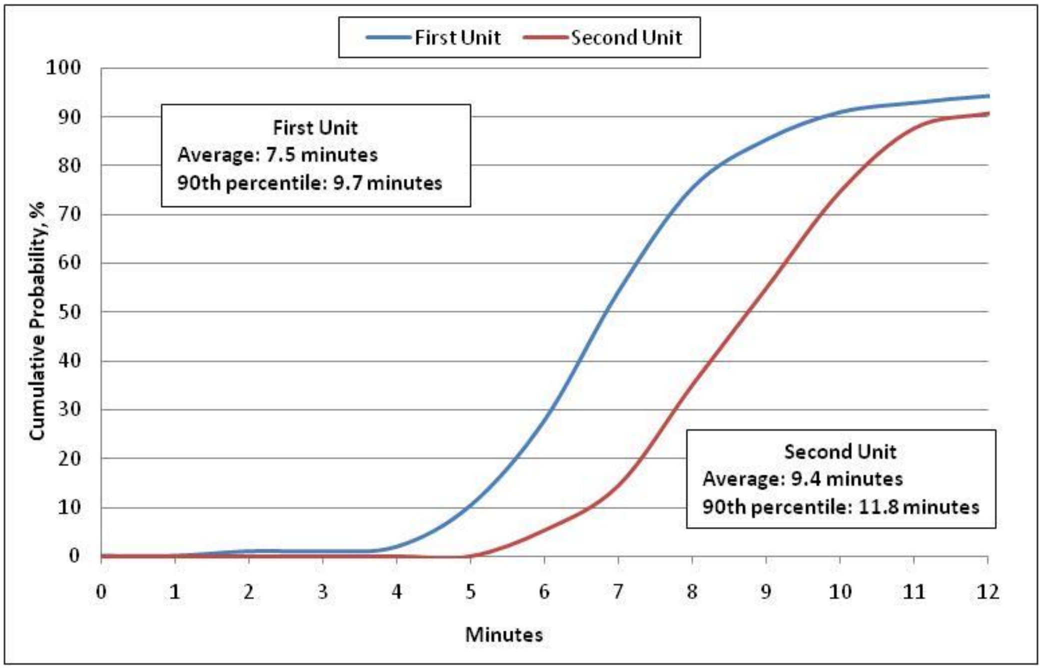


Table 24. Cumulative Distribution Function of Response Time of First and Second Arriving Fire Unit for Structure Fire Calls

Response Time	First Unit		Second Unit	
	Frequency	Cumulative Percent	Frequency	Cumulative Percent
0 - 1 min.	0	0.0	0	0.0
1 - 2 min.	2	0.9	0	0.0
2 - 3 min.	0	0.9	0	0.0
3 - 4 min.	2	1.9	0	0.0
4 - 5 min.	18	10.4	0	0.0
5 - 6 min.	37	27.8	7	5.3
6 - 7 min.	56	54.2	12	14.5
7 - 8 min.	45	75.5	27	35.1
8 - 9 min.	21	85.4	26	55.0
9 - 10 min.	12	91.0	26	74.8
10 -11 min.	4	92.9	17	87.8
11 - 12 min.	3	94.3	4	90.8
12 - 13 min.	1	94.8	3	93.1
13 - 14 min.	3	96.2	1	93.9
14 - 15 min.	1	96.7	0	93.9
> 15 min.	7	100.0	8	100.0

Observations:

- On average, the first fire unit’s response time was 7.5 minutes for structure fire calls.
- On average, the second fire unit’s response time was 9.4 minutes for structure fire calls.
- 90 percent of the time, the first fire unit’s response time was less than 9.7 minutes for structure fire calls.
- 90 percent of the time, the second fire unit’s response time was less than 11.8 minutes for structure fire calls.

Figure 23. Cumulative Distribution Function of Response Time of First and Second Arriving Fire Unit for Outside Fire Calls

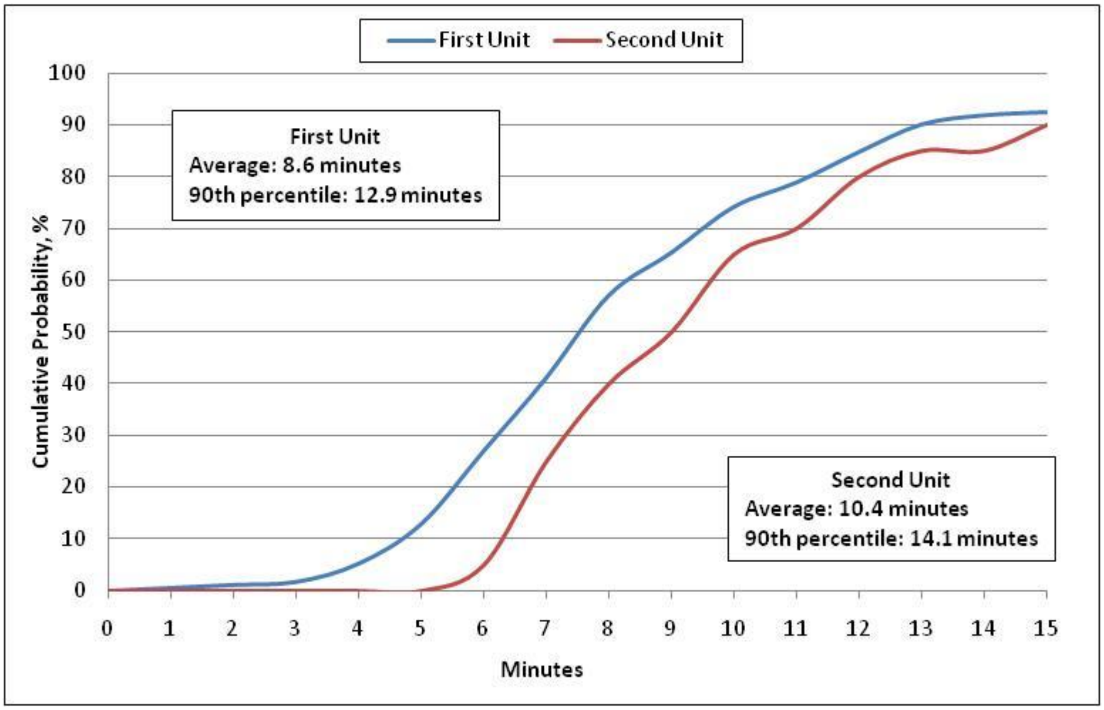


Table 25. Cumulative Distribution Function of Response Time of First and Second Arriving Fire Unit for Outside Fire Calls

Response Time	First Unit		Second Unit	
	Frequency	Cumulative Percent	Frequency	Cumulative Percent
0 - 1 min.	1	0.6	0	0.0
1 - 2 min.	1	1.2	0	0.0
2 - 3 min.	1	1.8	0	0.0
3 - 4 min.	6	5.3	0	0.0
4 - 5 min.	13	12.9	0	0.0
5 - 6 min.	24	27.1	1	5.0
6 - 7 min.	24	41.2	4	25.0
7 - 8 min.	27	57.1	3	40.0
8 - 9 min.	14	65.3	2	50.0
9 - 10 min.	15	74.1	3	65.0
10 -11 min.	8	78.8	1	70.0
11 - 12 min.	10	84.7	2	80.0
12 - 13 min.	9	90.0	1	85.0
13 - 14 min.	3	91.8	0	85.0
14 - 15 min.	1	92.4	1	90.0
> 15 min.	13	100.0	2	100.0

Observations:

- On average, the first fire unit's response time was 8.6 minutes for outside fire calls.
- On average, the second fire unit's response time was 10.4 minutes for outside fire calls.
- 90 percent of the time, the first fire unit's response time was less than 12.9 minutes for outside fire calls.
- 90 percent of the time, the second fire unit's response time was less than 14.1 minutes for outside fire calls.

D. Analysis of the Busiest Hours in a Year

There is significant variability in the number of calls from hour to hour. One special concern relates to the fire resources available for hours with the heaviest workload. We tabulated the data for the 8,760 hours in the year. Approximately once every 17 hours, the fire department responded to three or more calls in an hour. This is 5.8 percent of the total number of hours. In studying these call totals, it is important to remember that an EMS run lasts on average only 15.5 minutes and a fire category call lasts on average 20.2 minutes. Here, we report the top 10 hours with the most calls received and provide a detailed analysis of two of them.

Table 26. Frequency Distribution of the Number of Calls in an Hour

Number of Calls in an Hour	Frequency	Percentage
0	4330	49.4%
1	2776	31.7%
2	1144	13.1%
3	334	3.8%
4	96	1.1%
5-10	78	0.9%
11	1	0.0%
16	1	0.0%

Observations:

- During 510 hours (5.8 percent of all hours) in the year, three or more calls occurred. In other words, approximately once every 17 hours, the fire department responded to three or more calls in an hour.
- During 176 hours (2.0 percent of all hours) in the year, four or more calls occurred. In other words, approximately once every 50 hours, the fire department responded to four or more calls in an hour.
- During 80 hours (0.9 percent of all hours) in the year, five or more calls occurred.

Table 27. Top 10 Hours with the Most Calls Received

Hour	Number of Calls	Number of Runs	Total Busy Minutes
06/18/2010, 09 p.m. to 10 p.m.	16	29	779
07/28/2010, 03 p.m. to 04 p.m.	11	11	381
07/15/2010, 06 p.m. to 07 p.m.	10	11	166
07/23/2010, 06 p.m. to 07 p.m.	8	15	336
06/06/2010, 01 a.m. to 02 a.m.	7	11	151
10/10/2010, 02 a.m. to 03 a.m.	7	8	117
10/09/2010, 04 p.m. to 05 p.m.	7	8	105
10/09/2010, 11 a.m. to 12 p.m.	7	8	92
10/09/2010, 02 p.m. to 03 p.m.	7	7	128
10/09/2010, 02 a.m. to 03 a.m.	7	7	76

Note: The combined workload is the total busy minutes spent responding to calls received during the hour, and may extend into the next hour or hours.

Observations:

- The hour with the most calls received was 9 p.m. to 10 p.m. on June 18, 2010. The 16 calls involved 29 runs. The combined workload was 779 minutes, which may extend into subsequent hours. This was the result of two EMS calls, two structure fire calls, one outside fire call, nine hazardous condition calls (wires arcing or down), and two alarm calls. June 18, 2010 was the opening day for Ann Arbor summer festival and had a thunderstorm.
- The hour with the second most calls received was 3 p.m. to 4 p.m. on July 28, 2010. Eleven calls involved 11 runs and were the result of one fall and injury call, nine hazardous condition calls, and one alarm call. The longest call was a hazardous condition call and lasted one hour, 40 minutes. There was a storm on July 28, 2010.
- The hour with the third most calls received was 6 p.m. to 7 p.m. on July 15, 2010. Ten calls involved 11 runs. There were one alarm call, eight hazardous condition calls (wires arcing or down), and one public service call. The longest call was a hazardous condition call, which lasted 34 minutes.

- In summary, hazardous condition calls were the primary reason for a large number of calls.

Table 28. Unit Workload Analysis between 9 p.m. and10 p.m. on Friday, June 18, 2010

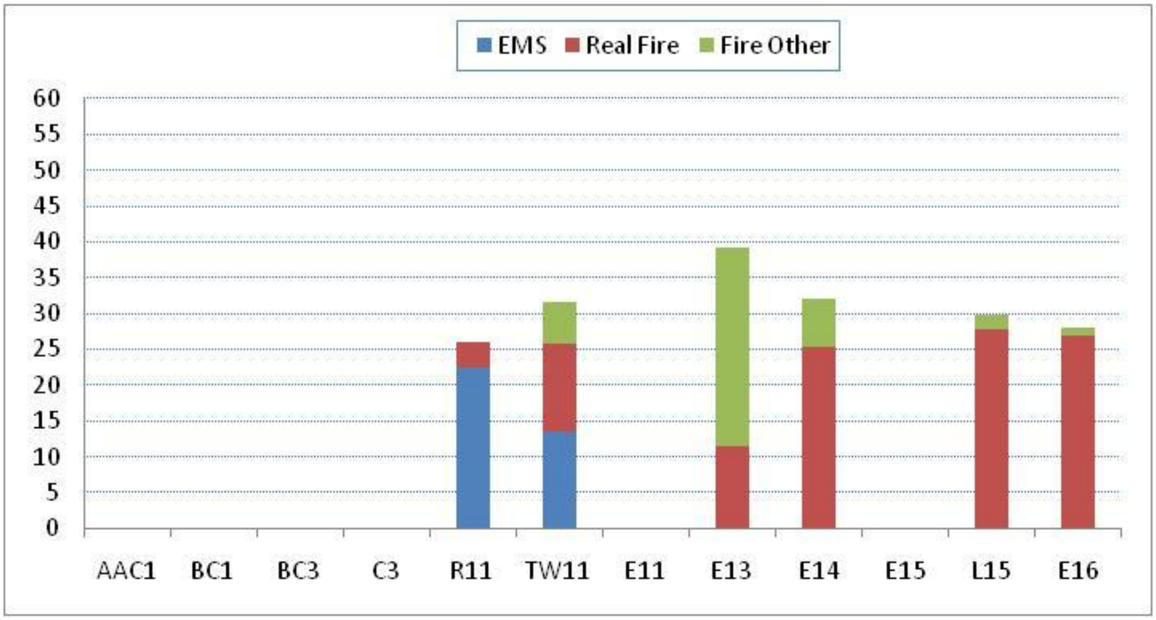
Station	1							3	4	5		6		Number of Busy Units
Type	Chief	Command			Rescue	Aerial	Pumper	Pumper	Pumper	Pumper	Quint	Pumper	Haz-Mat	
Unit	AAC1	BC1	BC3	C3	R11	TW11	E11	E13	E14	E15	L15	E16	HZ1	
0-5														0
5-10														0
10-15														0
15-20														0
20-25					1.9			4.2						2
25-30					5.0	1.8		5.0	2.3			1.0		5
30-35		3.7			5.0	5.0		5.0	4.9		4.7	2.2		7
35-40		5.0			5.0	5.0		5.0	5.0		5.0	4.9		7
40-45		5.0			5.0	5.0		5.0	4.9		5.0	5.0		7
45-50		5.0			0.6	4.9		4.9	5.0		5.0	5.0		7
50-55		5.0				5.0		5.0	5.0		5.0	5.0		6
55-60		5.0			3.4	5.0		5.0	5.0		5.0	5.0		7
Total		28.7			25.9	31.7		39.1	32.1		29.7	28.1		

Note: The numbers in the cells are the busy minutes within the five-minute block. Cells with values greater than 2.5 are shaded in red.

Observation:

- June 18, 2010, was the opening day for Ann Arbor's summer festival. A total of 16 calls occurred during this hour. One structure fire call involved all seven units and lasted two hours, 3.4 minutes. The rest of the 15 calls lasted less than half an hour. Nine calls involved one unit, five calls involved two units, and one call involved three units. During the busiest portion of the hour (total of 25 minutes), seven units were busy. A total of three units were busy more than 30 minutes during this hour.

Figure 24. Unit Workload Analysis by Call Type between 9 p.m. and10 p.m. on Friday, June 18, 2010



Observations:

- Busy minutes for the EMS calls totaled 35.9 minutes, which accounted for 19.2 percent of the total busy minutes during the hour.
- Busy minutes for structure fire calls totaled 107.4 minutes, which accounted for 57.6 percent of the total busy minutes during the hour.
- Busy minutes for fire other calls totaled 43.3 minutes, which accounted for 23.2 percent of the total busy minutes during the hour.

Table 29. Unit Workload Analysis between3 p.m. and4 p.m. on Wednesday, July 28, 2010

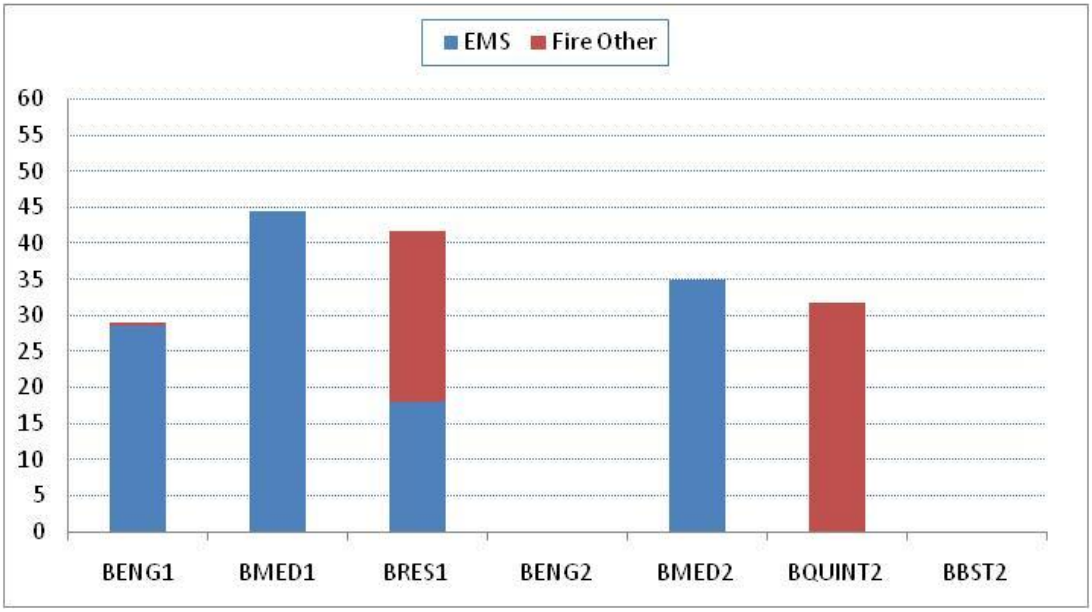
Station	1							3	4	5		6		Number of Busy Units
Type	Chief	Command			Rescue	Aerial	Pumper	Pumper	Pumper	Pumper	Quint	Pumper	Haz-Mat	
Unit	AAC1	BC1	BC3	C3	R11	TW11	E11	E13	E14	E15	L15	E16	HZ1	
0-5														0
5-10														0
10-15														0
15-20														0
20-25					3.3			1.9	1.3	4.4		0.8		5
25-30					5.0			5.0	5.0	5.0	3.1	5.0		6
30-35					5.0			5.0	5.0	4.6	5.0	5.0		6
35-40					5.0			5.0	5.0	5.0	5.0	4.9		6
40-45					5.0			5.0	4.8	4.5	5.0	4.6		6
45-50					5.0			5.0	5.0	0.8	5.0	5.0		6
50-55					5.0			5.0	5.0	5.0	5.0	5.0		6
55-60					5.0			5.0	5.0	3.3	5.0	5.0		6
Total					38.3			36.9	36.1	32.6	33.1	35.3		

Note:The numbers in the cells are the busy minutes within the five-minute block. Cells with values greater than 2.5 are shaded in red.

Observation:

- There was a storm on July 28, 2010. A total of 11 calls occurred during this hour. Each call involved only one unit. Three hazardous condition calls lasted longer than one hour and the rest of the calls lasted less than 30.4 minutes. During the busiest portion of the hour (total of 35 minutes), six units were busy. All six units dispatched in this hour were busy more than 30 minutes.

Figure 25. Unit Workload Analysis by Call Type between 5 p.m. and6 p.m. on Saturday, June 5, 2010



Observations:

- Busy minutes for EMS calls totaled 8.7 minutes, which accounted for 4.1 percent of the total busy minutes during the hour.
- Busy minutes for fire category calls totaled 203.6 minutes, which accounted for 95.9 percent of the total busy minutes during the hour.

E. Response Time Analysis of EMS Calls Responded to by Both Huron Valley Ambulance and Fire Department

Among the 4,668 EMS calls responded to by the fire department, we were able to match 4,483 EMS calls (96 percent), which were also responded to by the Huron Valley Ambulance (HVA). In addition, there are a total of 205 EMS calls, which were only responded to by the private ambulance company. This section focuses on response time analysis of the 4,483 EMS calls responded to by both the fire department and HVA.

Table 30. Who Arrived Earlier for EMS Calls: HVA or Ann Arbor Fire Department Unit

Description	Number of Calls	Percentage
Ann Arbor Fire Department unit and HVA's ambulance both missed unit on-scene time	169	3.8%
Ann Arbor Fire Department unit missed on-scene time	130	2.9%
HVA's ambulance missed unit on-scene time	428	9.5%
Ann Arbor Fire Department unit and HVA's ambulance arrived together	12	0.3%
HVA's ambulance arrived earlier	1,724	38.5%
Ann Arbor Fire Department unit arrived earlier	2,020	45.1%
Total	4,483	100.0%

Observations:

- A total of 727 calls (16.2 percent) missed unit on-scene time of either the private ambulance or fire department responding unit.
- In a total of 1,724 calls, an HVA ambulance arrived earlier. This accounted for 38.5 percent of the total calls, to which both private ambulance and fire department unit have responded.
- In a total of 2,020 calls, the Ann Arbor Fire Department unit arrived earlier. This accounted for 45.1 percent of the calls, to which both private ambulance and fire department unit have responded.

Table 31. Response Time Analysis of the First Arriving Private Ambulance and the First Arriving Ann Arbor Fire Department Unit by EMS Call Type

Call Type	HVA					Ann Arbor Fire Department (AAFD)				
	Dispatch Time	Turnout Time	Travel Time	Response Time	Percentage of Calls HVA Arrived Earlier than AAFD	Dispatch Time	Turnout Time	Travel Time	Response Time	Percentage of Calls AAFD Arrived Earlier than HVA
Cardiac and Stroke	1.1	0.8	5.1	7.0	40.2%	1.2	2.2	3.5	6.7	59.3%
Breathing Problem	1.0	0.8	5.3	7.1	48.3%	1.2	2.2	3.5	6.8	51.0%
Overdose and Psychiatric	1.4	0.8	5.9	8.1	55.0%	2.0	2.4	3.6	8.0	45.0%
Fall and Injury	1.3	0.8	5.7	7.7	45.6%	3.3	2.3	3.6	8.9	54.4%
MVA	1.1	0.8	5.2	7.0	44.9%	1.4	2.0	3.4	6.6	54.9%
Medical Other	1.2	0.8	5.3	7.2	44.4%	1.7	2.2	3.2	6.9	55.2%
Total	**1.2**	**0.8**	**5.3**	**7.3**	**45.9%**	**1.7**	**2.2**	**3.4**	**7.1**	**53.8%**

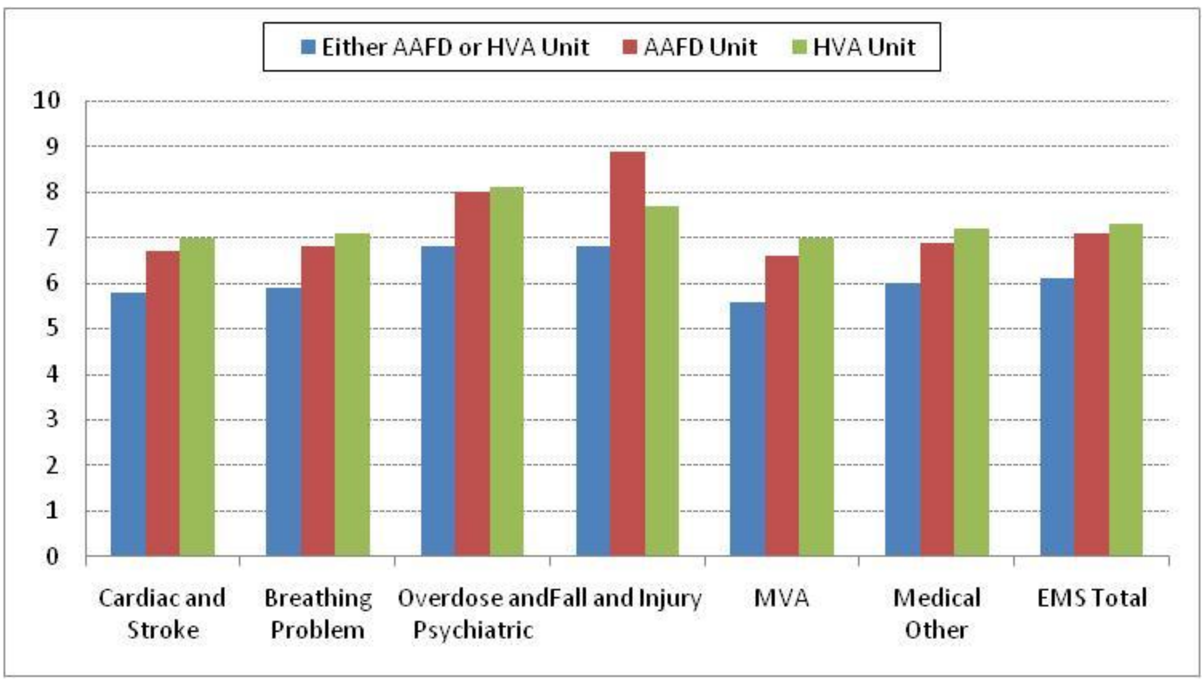
Observations:

- The average dispatch time for the private ambulance is 1.2 minutes vs. 1.7 minutes for the Ann Arbor Fire Department.
- The average turnout time for the private ambulance is 0.8 minutes vs. 2.2 minutes for the Ann Arbor Fire Department.
- The average travel time for the private ambulance is 5.3 minutes vs. 3.4 minutes for the Ann Arbor Fire Department.
- For calls with both arrival times, an Ann Arbor Fire Department unit arrived at 53.8 percent of the EMS calls earlier than the HVA unit.

Table 32. Response Time Analysis of the First Arriving Ann Arbor Fire Department or HVA Unit by EMS Call Type

Call Type	Response Time of the First Arriving Unit		
	Either AAFD or HVA Unit	AAFD Unit	HVA Unit
Cardiac and Stroke	5.8	6.7	7.0
Breathing Problem	5.9	6.8	7.1
Overdose and Psychiatric	6.8	8.0	8.1
Fall and Injury	6.8	8.9	7.7
MVA	5.6	6.6	7.0
Medical Other	6.0	6.9	7.2
Total	**6.1**	**7.1**	**7.3**

Figure 26. Response Time of the First Arriving Ann Arbor Fire Department or HVA Units



Observations:

- The response time of the first arriving unit (either an Ann Arbor Fire Department or an HVA unit) was 6.1 minutes, which was a minute shorter than the response time of the first arriving Ann Arbor Fire Department unit.

Table 33. Response Time Analysis of the First Arriving Unit by EMS Call Type

Call Type	AAFD Unit Arrived Earlier			HVA Unit Arrived Earlier		
	AAFD Response Time	HVA Response Time	Difference	AAFD Response Time	HVA Response Time	Difference
Breathing Problem	6.1	8.4	2.2	7.8	5.5	2.3
Cardiac and Stroke	5.9	8.4	2.5	7.6	5.6	2.0
Fall and Injury	6.5	9.0	2.6	10.8	6.5	4.4
MVA	5.4	8.2	2.9	8.1	5.9	2.2
Medical Other	5.9	8.5	2.6	8.3	5.8	2.5
Overdose and Psychiatric	6.8	9.6	2.8	9.5	6.8	2.7
Total	**6.0**	**8.6**	**2.5**	**8.5**	**5.9**	**2.6**

Observations:

- When the Ann Arbor Fire Department unit arrived on scene earlier than the HVA unit, on average it arrived 2.5 minutes earlier.
- When the HVA unit arrived on scene earlier than the Ann Arbor Fire Department unit, on average it arrived 2.6 minutes earlier.

Appendix I. Workload Analysis of Administrative Units

Unit Id	Unit Description	Number of Runs	Total Busy Hours
AAC1	Fire Chief	2	0.6
BC1	Command	254	133.3
BC3	Command	14	7.1
C3	Command	1	2.2
FP1	Investigator	8	11.3
FP3	investigator	6	8.9
FP4	Investigator	4	9.6
Total		**289**	**173.1**

Appendix II. Property and Content Loss Analysis for Structure or Outside Fire Calls

Call Type	Property Loss			Content Loss		
	Number of Calls	Total	Average	Number of Calls	Total	Average
Outside Fire	12	$ 38,550	$ 3,213	2	$ 1,500	$ 750
Structure Fire	24	$ 947,200	$ 39,467	24	$ 398,800	$16,617

Observations:

- A total of 12 outside fire calls involved property loss and the average property loss value was $3,213. A total of two outside fire calls involved content loss and the average content loss value was $750.
- A total of 24 structure fire calls had property loss and the average property loss value was $39,467. A total of 24 structure fire calls had content loss and the average content loss value was $16,617.