A CRITICAL REVIEW OF THE LEVEL OF SERVICE PROVIDED BY THE HAMILTON FIRE DEPARTMENT

Advanced Leadership Issues In
Emergency Medical Services

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ABSTRACT

The effectiveness of the Suppression Division of the Hamilton Fire Department is of prime concern to the administration, elected officials, and residents of the City of Hamilton. Unfortunately, a comprehensive quality assurance (QA) process has not been established that would allow the Department to continuously evaluate itself and constantly strive for performance improvement. The purpose of this applied research project was to utilize a quality management approach to establish an appropriate level of service for the Department.

By utilizing the descriptive research methodology, the author answered the following questions: what are the critical elements of a QA process?; what system factors affect the delivery of fire and EMS services?; what is the level of service provided by other comparable departments?; what are appropriate goals for the Hamilton Fire Department?; what is the current level of performance; and, what changes, if any, should the Department undertake to continuously improve the level of service?

The research procedure involved a literature review of reference material located at the Learning Resource Centre at the National Fire Academy, the City of Edmonton Public Libraries, and the Office of the Fire Marshal in Toronto, Ontario. A 10-question survey was also sent to 46 departments who are members of the Metropolitan Fire Chiefs Association in an effort to compare the level of the service.

As a result of this applied research project, the author identified five distinct components of an effective QA process and five key system elements affecting the delivery of fire and EMS services. Performance objectives, expressed as fractal numbers, were identified for response time, number of personnel, and apparatus and equipment elements of the service delivery model.

Several recommendations were made with regard to the continuous improvement in the level of fire and EMS services provided by the Department. After recommending performance objectives for the Department, the author also stressed the need to expedite the procurement of a computer aided dispatch system to assist in the evaluation of system performance. It was also recommended that any new initiatives be evaluated according to their impact on the performance objectives established for the Department. Continued efforts at promoting early detection and the adoption of competency-based training, benchmarking and post-incident analyses were also endorsed. Finally, the need to establish a QA committee to monitor system performance was also stressed.

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INTRODUCTION

The purpose of this applied research project is to utilize a quality management approach to establish an appropriate level of service for the Suppression Division of the Hamilton Fire Department.

In conducting this research, the author utilized the descriptive research methodology to review the management literature and survey other fire departments for the purposes of answering the following questions:

- What are the critical elements of a quality assurance process?
- What system factors affect the delivery of fire and emergency medical services?
- What is the level of service provided by other municipal fire departments in comparable cities in Canada and the US?
- What are appropriate goals for the Suppression Division of the Hamilton Fire Department?
- What is the current level of performance of the Suppression Division of the Hamilton Fire Department?
- What changes, if any, should the Hamilton Fire Department undertake to continuously improve the level of fire and emergency medical service that is provided?

BACKGROUND AND SIGNIFICANCE

Hamilton

The City of Hamilton is a city at the west end of Lake Ontario, which is nestled in the heart of the *Golden Horseshoe* against the Niagara Escarpment. With a population of approximately 322,000, it is the fourth largest city in Ontario, and the ninth largest in Canada. A major centre of manufacturing and an important lake port, Hamilton is the largest of the six municipalities that form the Regional Municipality of Hamilton-Wentworth.

The City is divided into two sections. The upper City features largely post-World War II development with an inherently less hazardous building stock. The lower City is older, having a core of commercial, residential, and industrial buildings, transportation and hazardous material risks.

Over 50% of goods and services produced in the Hamilton-Wentworth Region are exported beyond the Region's borders. The City of Hamilton is home to Canada's two largest steel producers (Stelco and Dofasco) and other prominent manufacturing firms such as Westinghouse Canada and Procter & Gamble. The City is also home to McMaster University, Mohawk College, and several acute care hospitals.

The Department

The City of Hamilton Fire Department is a large metropolitan fire department with a staff of 445 personnel and 11 stations. In addition to providing emergency medical care and fire suppression services, Hamilton Fire Department personnel also provide services for disaster preparedness, including the management and control of hazardous materials incidents and spills. In recent years, the Department has broadened its capabilities to perform high-angle and low-angle rope rescues, land-based water and ice rescues, and confined space entry. In 1997 the

Hamilton Fire Department responded to over 16,000 requests for service, with emergency medical responses representing over 60% of the emergency responses of the Hamilton fire suppression force. A private provider under contract to the Province of Ontario presently provides land ambulance services to the City of Hamilton.

The Problem

The effectiveness of the Suppression Division of the Hamilton Fire Department is of prime concern to the administration, elected officials, and residents of the City of Hamilton. The ultimate objective of the Department is to provide the highest level of service possible given the finite amount of resources that have been allocated to the Department. Unfortunately, the Hamilton Fire Department has not established a comprehensive quality management process that will allow the Department to continuously evaluate itself and constantly strive for performance improvement.

In order to evaluate the Department, it is first necessary to establish difficult but achievable goals for every behavior inherent in the service delivery system. To assist in this exercise, the City of Hamilton in 1996 retained the professional services of an external consultant to study the Department and identify levels of service. While the consultant conducted a thorough review of the Department and made recommendations for how the service could be improved, a level of service was never explicitly stated and formally adopted by Hamilton City Council. The Department has also not established an evaluation tool to evaluate every component in the system. This approach will allow the Department to justify its budgetary requests and to assess whether new initiatives will either contribute to or detract from the formally established goals for the service delivery system.

This research paper was prepared to satisfy the requirement of the Advanced Leadership Issues in Emergency Medical Services (ALIEMS) course, which is part of the Executive Fire Officer Program at the National Fire Academy. The research problem that was identified above is clearly related to the Quality Management module of the ALIEMS course for two reasons. First, the establishment of a quality management process will help to continually improve the fire protection and emergency medical services (EMS) provided by the Hamilton Fire Department. Second, since the Department is pursuing a greater role in the delivery of land ambulance services, the identification of goals and objectives and a process for continually monitoring system performance will help to determine whether this expanded role is a viable alternative.

LITERATURE REVIEW

In today's period of fiscal restraint, fire departments are constantly pressured to do more with less. It has also become increasingly more difficult to justify any increase in expenditures unless they can be attributed to improved or expanded service in the community. This effort is often hampered by a nationally accepted set of criteria by which a community can judge the level and quality of fire, EMS, and other services that are provided (Walter, 1996, p.101).

As fire service leaders strive to maximize their ability to improve community safety and health, Delbridge (1996) recommends that every fire department pursue a critical evaluation of their own effectiveness. The International Association of Fire Chiefs (IAFC) supports the need for evaluation by outlining situations where evaluation is warranted. For example, evaluation is useful when an organization is trying to cope with change or where it is necessary to provide for periodic organizational evaluations to ensure effectiveness. Evaluation is also beneficial

whenever there is a change in leadership and as a mechanism to raise the level of professionalism within the organization (IAFC, 1995, p. 2-31). Finally, the monitoring and management of patient care and system performance will be critical to the future success of EMS programs (Dittmar, 1983, p. 84).

Prior to the commencement of any program, it is important to recognize that program evaluation should be planned in advance, and not as an afterthought after the program or project has been completed. Administrators should develop management objectives and define expected outcomes before any program is implemented (Timmins 1985, p. 96). When setting goals and objectives, consideration must also be given as to whether it is possible to measure the results and that the goals are attainable (Ludwig, 1995, p. 55).

Quality Assurance Process

Program evaluation makes a systematic effort to determine if the organization and its management team are taking appropriate actions for the implementation of current or future activities to achieve pre-determined goals (IAFC, 1995, p. 2-17). Program evaluation also allows the organization to make the most effective and efficient use of a finite amount of resources. This evaluation is best accomplished through the use of a QA process.

Once established, the QA process must continuously evaluate all operations and constantly strive for performance improvement. According to Eastham (1991), an effective QA system should have a broad focus that permits assessment and improvement of each aspect of operations and involves each person in the organization. From an overall perspective, the organization must identify issues that affect the quality of service and methods by which to resolve them. This is achieved by implementing the following components of an effective QA program:

- program identification and prioritization (PIP);
- standards identification and validation;
- assessment; intervention;
- evaluation.

In the PIP phase, a list of issues that must be addressed to improve or maintain the quality of service is identified. For each of the issues identified, a comparison is made between the current base line level and the optimal achievable level to define a performance improvement zone.

The optimal achievable level for the program or project can be determined by reference to accepted industry standards and/or through a process referred to as *benchmarking*. Sendolini (1992) defines benchmarking as "a continuous, systematic process for evaluating the products, services, and work processes of organizations that are recognized as representing best practices for the purpose of organizational improvement". Benchmarking is a useful tool in the measurement, comparison, and analysis of organizational performance. These comparisons to the "best in the business" can be useful for developing baseline performance and developing performance improvement objectives. For example, in vertical benchmarking (that is staying in the industry), a fire department may look to other departments who have reputations for excellence and compare measures of quality, efficiency, and productivity which are similar (Walker, 1994, p. 5).

An assessment of the deficiencies that are causing the gap in performance is then undertaken to result in specific recommendations for performance improvement interventions. After the intervention has been implemented, a review is undertaken to determine if the intervention has been effective in adequately improving the improvement zone. As a final

consideration, Hogan (1996) recommends that the reviewer of a program should be independent of the operation being reviewed to ensure objectivity.

Performance Objectives

A significant amount of research has been undertaken regarding fire department performance objectives. Despite the amount of research, most suggested measures are subjective and difficult to standardize. Additionally, performance objectives may either be expressed as a single measure or as separate objectives for each of the key elements of the service delivery system identified.

O'Nieal (1992) proposes a standardized unit of fire protection as a method for analyzing whether an adequate level of service is provided. With a standardized, comprehensive measurement for fire risk and firefighting capability, the two figures would illustrate whether a community is over or under protected. Inherent in this approach, however, is the notion that there is a valid method for quantifying fire protection.

Laeng (1993) also proposes the use of two measures to calculate a single composite measure of effectiveness. Dividing property value saved (in dollars) by the assessed property value prior to fire derives the first measure, the *Property Coefficient*. The second measure, the *Life Safety Coefficient*, is derived by dividing the number of lives saved by the number of lives involved in all fire incidents. The overall *Effectiveness Coefficient* would then be an average of the two.

In contrast, Brannigan (1994) steadfastly opposes to use of annual dollar fire loss as a productivity measurement. If fire loss is used, then a truly efficient department will divert its efforts to those calls that have the highest potential property loss. Instead, Brannigan believes

that productivity measurements should include components associated with the response to the incident and with those associated with pre-fire planning, training, and maintaining equipment.

Granito and Dionne (1988) also conclude that performance objectives should include many parameters as opposed to a single composite measure. In particular, they argue that fire department goals and objectives should include the following parameters:

- acceptable level of fire loss;
- acceptable level of risk of loss of life due to fire;
- type and scope of emergency services;
- number of personnel constituting a first alarm assignment;
- amount of time between receipt of alarm and arrival of personnel; and
- measures associated with fire protection activities such as code development, enforcement, administration, and public education.

Despite this diversity in opinion, the most common approach has been to identify the elements that affect the delivery of service and develop specific performance objectives for each of these elements. To this end, the following five key elements have been identified:

1) response time;
2) number of personnel that respond to the call;
3) apparatus and equipment used;
4) level of training; and
5) methods employed.

While each of these factors is of considerable importance in defining how a fire department fulfills its role, more attention has been devoted to the establishment of performance objectives for the first three elements. As the preservation of life and property is directly related

to the time required to reach the scene of an emergency, and the personnel and equipment involved, it is reasonable to expect that these three elements have been more frequently relied upon as important indicators of the fire department's effectiveness. Collectively, these three elements help to define the "capability" of the department which is the ability to respond within a short time with sufficient trained personnel and equipment to rescue any trapped occupants and confine the fire to the room or building of origin, or to initiate emergency medical care.

Although the first of these elements is often referred to as the "response time", it can be further broken down into four sub-components:

1) detection time (no reliable data or analysis exists);

2) alarm processing time;

3) turnout time; and

4) travel time.

Using an average response time as a measure of performance may not be the most appropriate standard. Using an average response time tends to mask long response times as they can be offset by shorter response times. For example, four two-minute responses together with one 17-minute response result in an average five-minute response time, a respectable average response time, despite the exceedingly long response for one of the calls. The average response time may also create the customer expectation that the department can be on scene in any emergency in that period of time. Consequently, it is important to know the call distribution for a particular jurisdiction (Brewster, 1994, p.18). A standard coverage level of 90% has certain advantages over an average response time. The standard is deemed to be met when more than 90% of the calls are responded to in less than the specified time.

An important component of any fire and EMS delivery system is the dispatch process that evaluates the nature of the emergency and sends the appropriate resources in a timely fashion to deal with the situation. Dispatch protocols ensure that there is a standardized interrogation and response to different types of emergencies based upon the information obtained in the evaluation of the emergency. A case review process that evaluates compliance to the protocol, feedback reports from field and hospital personnel, and a continuing education program in response to the education needs identified through compliance to the protocol data analysis are the essential elements of any quality management process for dispatch activities (Clawson, 1998, p. 5).

In regards to standards for "alarm processing time", a recent study completed by the International Association of Fire Chiefs (IAFC) Accreditation Committee indicates that in "staffed departments" the average time required to process the alarm was 53.76 seconds (IAFC, 1992, p. 7). The Ontario Pre-Hospital Advanced Life Support (OPALS) Study (1994) also finds that the acceptable reaction time of an ambulance crew following notification of a call should not exceed one minute.

Officials need to establish a maximum response time following receipt of the dispatch instructions at the station for personnel to ready themselves for a response to the emergency. This sub-component of response time has been referred to as the "turnout time". In some urban areas, one and a half minutes is considered a desirable maximum. The IAFC Accreditation Committee (1992) in its survey of staffed departments also determined that the average turnout time was 57.55 seconds.

The last sub-component, "travel time", is a major component of the response time of a fire department and primarily is dependent on the distance from the fire hall to the location of the fire. However, the street arrangement, traffic volume, distance of the fire location from a public

road, and weather conditions are also factors that affect the travel time (Hadjisophocleous, 1995, p. 6).

In order to be even minimally effective in controlling a fire, the initial responding apparatus should reach the emergency scene in time to prevent flashover, which is typically in the order of eight to 10 minutes. The Office of the Fire Marshal indicates that rescue becomes a virtual impossibility in the room of origin after flashover occurs. After flashover, the opportunity for successful rescue from other areas in the structure rapidly diminishes. In addition, there is an increased firefighting demand if intervention does not take place prior to flashover (OFM, 1993, vii).

It is generally accepted that the first arriving piece of apparatus should be at the emergency scene within five minutes of the sounding of the alarm, since additional minutes are needed to size up the situation, deploy hose lines, and initiate search and rescue. This is consistent with past experience that has shown that the first five minutes of most fires is the determining factor as to whether that fire will remain a small fire or become a large fire. In dense urban settings, the desired response time is often shorter, with four minutes for the first responding pumper being the rule of thumb maximum time for 90% of urban areas (NFPA, 1997, 10-35).

In addition to recognizing the shortcomings associated with using an average response time, there are also limitations associated with restricting response criteria to the first responding unit. As a result, it is recommended that individual response objectives be set for each of the major types of units sent on the initial fire response (pumpers, aerials, and rescues).

A common rule of thumb is that a community using on-duty crews at fire stations should be able to have an initial attack team comprising an entire first-alarm response on the scene

within approximately eight minutes of receipt of the alarm. This equates to about six minutes of running time (NFPA handbook, 1997, 10-31). Those firefighters and vehicles that cannot arrive at the fire scene within the first critical time period have limited impact on the initial attack, regardless of the department's response assignment.

In regards to the delivery of effective EMS, early intervention is also critical. It is well recognized that early EMS system activation is essential to the survival of the cardiac arrest patient. The "chain of survival" for successful patient outcomes includes early access to the pre-hospital care system, early cardiopulmonary resuscitation, early defibrillation, and early advanced care (Spaite, 1994, p.2). Rapid defibrillation for cardiac arrest victims and airway management for some trauma victims remain the only EMS clinical interventions to enhance objective patient outcomes (Delbridge, 1996, p. 44). The American Heart Association emergency medical services maximum response time recommendation has been four minutes for initiation of basic life support (BLS) and eight minutes for initiation of advanced life support (ALS). Where fire departments provide emergency medical service, the widely recommended four-minute response for non-breathing or trauma victims is very important. For cardiac arrest, the highest hospital discharge rate has been achieved in patients on whom cardiopulmonary resuscitation (CPR) was initiated within four minutes of arrest and advanced cardiac life support (ACLS) within eight minutes. Early bystander rescue breathing , CPR intervention, and rapid emergency medical services (EMS) response are essential in improving survival rates.

The number of personnel and vehicles that respond to an incident is also important. The overall objective of any fire department is to provide its community with the optimum level of protection from fire and other related public safety hazards while, at the same time, ensuring an appropriate level of safety for its firefighters (OFM, 1993, p. 2). Staffing issues relate to the

number of personnel on each responding unit, as well as the total number of personnel that respond to each emergency.

The National Fire Protection Association (NFPA 1500, 1997, A-6-4.1, p. 39) recommends that a minimum acceptable fire company staffing level should be four members responding or arriving with each engine and each ladder company responding to any type of fire. The minimum acceptable staffing level for companies responding in high-risk areas should be five members responding or arriving with each engine company and six members responding or arriving with each ladder company. These recommendations are based on experience derived from actual fires and in-depth fire simulations and are the result of critical and objective evaluation of fire company effectiveness.

These studies indicate significant reduction in performance and safety where crews have fewer members than the above recommendations. Overall, five crew members were found to provide a more coordinated approach for search and rescue and fire suppression tasks. The Office of the Fire Marshal of Ontario (1993) also recommends, where practical, a minimum of four persons be dispatched on the initial apparatus.

The National Fire Protection Association Training Standard for Initial Attack (NFPA, 1995, p. 5) outlines the requirements for an initial interior attack on working structural fires. This standard outlines a sufficient number of firefighters to operate the hose streams and pumpers, plus a truck company capable of simultaneously performing forcible entry, search and rescue, ventilation, raising of ladders, salvage operations, and the operation of various tools carried on the truck. The entire operation is directed and coordinated by a Chief Officer. With these requirements in mind, the desirable number of personnel normally required to respond with the apparatus to give this level of performance with properly manned hose streams and

equipment would be approximately 15 plus the Chief. The operation may be performed with slightly less firefighters where weaker truck service is provided, albeit with reduced efficiency.

Successful and safe interior structural fire attack minimally requires at least four firefighters arriving with the first due pumper and total fireground resources of 15 to 16 personnel staffing two pumpers and one ladder truck. Various controlled and statistically based experiments by some cities and universities reveal that if 16 trained firefighters are not operating at the scene of a working fire within the critical time period, then dollar loss and injuries are significantly increased, as are the square feet of fire spread (ICMA, p. 119).

While the number of firefighters dispatched is dependent on a number of factors, it is important to note that in the spectrum of environments protected by 41 of the fire departments making up a portion of the Metropolitan Chiefs Section of the International Association of Fire Chiefs, no department in 1995 dispatched fewer than 13 firefighters (including a Command Officer) to a reported fire in a single family detached dwelling. The average number dispatched was 18.6 (as cited in NFPA, 1997, 10-33).

The NFPA also delineates different resource requirements for various types of occupancies (NFPA, 1997, p.10-34). For example, it is recommended that at least four pumpers, two ladder trucks, two Chief Officers, and other specialized apparatus as needed, be dispatched to high hazard occupancies (such as hospitals and other large institutions) for a total requirement of not less than 24 firefighters and two Chief Officers. For medium hazard occupancies (apartments, offices, and normal industrial occupancies), it is recommended that 16 firefighters and one Chief Officer be dispatched. Lastly, for low-hazard occupancies (one or two family dwellings), it is recommended that at least 12 firefighters be dispatched.

A second important concept that relates to the number of firefighters that are deployed by a fire department is the "capacity" of the department. This refers to the ability of the fire department to respond adequately to multiple-alarm incidents and/or simultaneous calls of any type. Larger municipalities typically average more demand for capacity and thus have larger departments. Obviously, remaining capacity is diminished as suppression units are deployed.

The more arduous the expectations placed on the mobile fire suppression crew, the greater the required resources. For example, the community that expects its fire department to contain fires to the room of origin should expect to provide more fire suppression resources than the community that expects the department only to prevent the spread of fire from one building to another. The more extensive the concentrated fire potential, the greater the required fire suppression resources. Given the same expectations of its mobile fire suppression force, a community having high-rise buildings, a high population density, and extensive industrial risks will normally require greater fire suppression resources than a largely residential community. Similarly, the broader the services provided by a fire protection agency, the greater the need for resources. For example, a fire agency providing emergency medical services will, given the same level of expectations for its mobile suppression forces, require more resources than an agency providing only fire protection services, assuming a significantly increased total workload demand, and a significant increase in simultaneous calls.

In a somewhat related approach, the Fire Underwriters (1996) utilize a risk classification approach to determine the appropriate numbers and timeliness of response for fire apparatus and personnel. The fire risk of a community is classified according to criteria reflecting: building size, construction and occupancy; structural configuration; exposed neighboring buildings;

exceptional life risk; and firefighting activity ancillary to delivery of water. With these criteria, a determination of the theoretical fire flows necessary to control a potential fire is derived.

With regards to effective staffing requirements for EMS calls, the American Medical Association states that most experts agree that a minimum of four responders (at least two trained in Advanced Cardiac Life Support and two in Basic Life Support) are the minimum required for cardiac arrest victims.

PROCEDURES

The research procedure utilized in preparing this research project consisted of a literature review that was conducted initially at the Learning Resource Center at the National Fire Academy in June of 1997. A literature review was also conducted in December, 1997 and in January, 1998 through the on-line data base of the Edmonton Public Libraries in Edmonton, Alberta and the Office of the Fire Marshal of Ontario in Toronto, Ontario. Finally, the author's personal collection of articles relating to QA and performance measurement in the fire service was also utilized.

A random sample of 46 departments who are members of the Metropolitan Fire Chiefs Association were also surveyed in an attempt to compare the level of service provided by the responding department with the Hamilton Fire Department. The questionnaire that was utilized and a listing of the members of the Metropolitan Fire Chiefs Association who were surveyed can be found in **Appendix #1.** The primary objectives in employing this survey instrument were to ascertain performance objectives and staffing levels used in other similar fire departments. The survey instrument was sent to each of the departments identified within the sample and returned by fax. A summary of the survey results is included in **Appendix #2.**

In determining the selection of the Canadian and US departments to be surveyed, the author randomly selected a cross section of departments from across Canada and the US in an attempt to avoid any regional variations with respect to the level of service provided by the local department. The decision to include both Canada and US in the sample selection was based on the relatively few departments in Canada who are members of the Metropolitan Fire Chiefs Association and who are comparable to the City of Hamilton. The Metropolitan Fire Chiefs Association was chosen on the premise that similar comparisons could be made between departments whom are typically large, predominantly full-time departments serving populations in excess of 250,000 people.

In general terms, there are also many similarities in terms of the political and legislative environment, the operating practices, and types of services provided by fire departments in both nations. A correlation analysis on the level of service provided by the Departments surveyed in Canada and the US was not performed during this applied research project. However, the author suspects there would be a high correlation between the two countries given the similarities of the environments in which fire departments operate in both Canada and the US.

The objective in determining the sample size was to try and achieve a response rate of at least 30 observations, which in statistical terms is considered as the minimum acceptable sample size for a random distribution. Of the 46 departments surveyed, 24 of them or 52% of the initial sample returned their completed survey.

LIMITATIONS

Before arriving at any conclusion with respect to the results of the survey, the following limitations must be raised. Given a sample size of 46 departments, the results should not be construed as representative of the entire fire service. In addition, some of the respondents failed

to complete all parts of the survey, which further calls into question the accuracy of the results. Lastly, it was assumed that the respondents understood all parts of the survey and were knowledgeable of various aspects of the level of service provided by their Department.

For the purposes of this applied research project, the following definition of terms was utilized. ***Level of service*** in the context of the delivery of fire and EMS service is a defined statement describing the number, type, and general purpose of personnel/apparatus sent to an emergency incident within a pre-determined time period. For example, the statement "it is the objective of this fire department to send a minimum of 15 firefighting personnel to carry out an aggressive interior attack in less than 8.0 minutes, 90% of the time" may be a possible definition of a level of service. ***Quality*** has been defined as "meeting the needs and expectations of any individual to whom the local department serves". In this context, "quality" includes both the clinical quality of fire and medical care (both process and outcome) and the customer's perception of that care. ***Response time*** has been defined as the time from the receipt of the call for assistance until the arrival of the apparatus at the scene of the emergency.

RESULTS

At the outset of this applied research project, several questions were raised. The first question attempted to outline the critical elements of an effective QA process. The literature review revealed that an effective QA system should have a broad focus that permits assessment and improvement of each aspect of the organization. Further, the program should involve each person in the organization and continuously strive for performance improvement. An effective QA process also has five distinct components, which include:

1) program identification and prioritization stage;

2) standards identification and validation;

3) assessment;

4) intervention; and

5) evaluation.

Finally, performance objectives must be established in advance of program implementation by referring to industry standards or through a benchmarking process.

In regards to the second research question, the author concluded there were several system factors that affect the delivery of fire and emergency medical services. Obviously, the amount of financial resources afforded to the fire department will determine, to some extent, the potential level of service that can be offered, provided these resources are effectively and efficiently utilized. Notwithstanding the level of financial resources, five key system factors affect the delivery of service:

1) response time;

2) number of personnel that respond to a call;

3) apparatus and equipment used;

4) level of training; and

5) methods employed.

What is the level of service provided by other municipal fire departments in comparable cities in Canada and the US? Although the answer to this question is complex, the survey provided some insight into this issue. All of the departments surveyed were mandated to provide an aggressive interior attack given the comparison involved large full-time departments. In addition, all of the departments surveyed were involved in the delivery of EMS services, with EMS responses comprising greater than 75% of all responses for the largest percentage of

respondents. Although 79% of the respondents have established service level objectives, less than 50% have separate objectives for fire and EMS services. In terms of the objectives themselves, 38% have expressed their response objectives as an average response time as compared with 46% of the respondents who expressed them as a fractal number.

As for specific response objectives, the following comments can be made regarding the survey results. For the first arriving pumper company, average response times vary from four to eight minutes, with the majority of respondents establishing four minutes as an average response time. For those departments with fractal objectives, the range of objectives was diverse from a low of "less than four minutes, 60% of the time" to a high of "less than eight minutes, 90% of the time". The most common fractal objective was "less than five minutes, 90% of the time".

Service level objectives for subsequently arriving pieces of apparatus were more diverse. Objectives for the arrival of the second pumper company varied from an average response time of six to eight minutes. As for the fractal objectives that were observed, the results varied from a low of "less than six minutes" to a high of "less than eight minutes" for 90% of all responses. Similarly, service level objectives for ladder units varied from an average response time of six to eight minutes, to a fractal objective of aerial responses to all emergency calls with eight minutes, 90% of the time. Response time objectives for rescue units were all expressed as a fractal number with a low of "less than four minutes 60% of the time" to a high of "less than 12 minutes, 90% of the time".

In terms of the staffing of fire apparatus, the survey indicates that the majority of departments staff pumper units with four firefighters, with a low of three and a high of five firefighters observed. As for the staffing of rescue units, the survey indicated that the majority of fire departments had four firefighters, although a low of two and a high of five firefighters were

observed. Ladder units are also staffed at similar levels with the majority of respondents utilizing four firefighters. Again, a low of two and a high of five firefighters on aerial units was observed.

The total number of firefighters sent to a first alarm structure fire varied greatly between 12-36 firefighters, depending on the nature of the first alarm response (be it to a high-rise or other high-risk incident). However, an average of 17 firefighters were sent to a first alarm structure fire amongst the departments surveyed. EMS responses typically demand only a single unit response with an average of four firefighters.

In assessing the current level of performance for the Hamilton Fire Department Suppression Division, the following observations were made. At the present time, only the response time of the first arriving unit (regardless of the type) is recorded. Response times are also tracked by City ward boundaries as outlined in **Table 1** below. For the years 1994, 1996, and 1997, city-wide average response times in the City of Hamilton were 3.6, 4.1, and 3.7 minutes respectively[†].

Table 1 – Average Response Times by Ward

Ward	1994	1995	1996	1997
1	3.4	-	4.6	4.3
2	3.0	-	3.2	3.1
3	3.5	-	3.6	3.6
4	3.3	-	3.3	3.4
5	4.5	-	5.0	4.4
6	3.3	-	3.6	3.4
7	4.0	-	4.4	3.6
8	3.9	-	4.9	3.8
City Average	**3.6**	-	**4.1**	**3.7**

[†]Note: A historical record of response times was not kept for 1995 and the majority of 1996. The 1996 figures reflect data for the last two months of 1996 when the process to collect this data was re-established. Staff and equipment reductions also occurred after 1994.

Covelli (1996) evaluated the performance of the Suppression Division of the Hamilton Fire Department against standards that are largely equivalent to the guidelines of the Fire Underwriters Survey. A copy of these standards has been included in **Appendix #3** of this applied research project. The analysis of response capability of pumpers in the City of Hamilton shows that their locations and those of their stations are satisfactory. A proportion of the fire demand zones (26%) was not covered within the pumper company travel time standards used. This is consistent with the situation in 10 other Canadian cities. Covelli also found that the second due or backup pumper company is normally available within the standard travel time in all but 14% of the fire risk weighted demand zones. Finally, Covelli concluded that the response capability of aerial and rescue companies was also within an acceptable range.

DISCUSSION

Measuring the standard of protection is a complex and difficult task. In addition to being responsible for the preservation of life and property associated with fire, the Hamilton Fire Department is also part of the tiered response system for emergency medical calls. As a result, Department objectives must not only take into account issues associated with fires but should reflect emergency medical response. This exercise is further complicated by the lack of legislatively prescribed guidelines and the fact that each community presents its own unique set of circumstances with regards to the fire risk and the pre-hospital care needs that are to be addressed by the local fire department.

Notwithstanding these difficulties, the results of this applied research project have several implications for the Suppression Division of the Hamilton Fire Department and will answer the final two research questions. So what are appropriate goals for the Suppression Division and

what changes should the Department undertake to continuously improve the level of fire and emergency medical service that is provided?

To answer these questions, it is useful to review the findings of this study in the context of the present situation within the Hamilton Fire Department. Since the objective of the Hamilton Fire Department is to provide the highest level of service to the residents of the City of Hamilton, a formalized QA process needs to be established. Presently, the Department has not established this type of process for all aspects of the service delivery model, although there is QA process in place for medical calls that have required defibrillation by fire department personnel. However, it could be argued that the post-incident debriefings held after major fire alarms, the establishment of policies and procedures, and the process for establishing Departmental training programs are consistent with a QA approach for the "methods used" and "level of training" elements of the service delivery model.

As stated previously, the first step in this process is to define objectives and outcomes for every behavior in the service delivery system. In establishing these objectives, it is important to keep in mind that a fractal objective is a more meaningful measure of the level of service than an objective expressed as an average number.

With regards to the first key element of service delivery model, *response time*, objectives need to be developed for each sub-component including detection time, alarm processing time, turnout time and travel time. Presently, the Hamilton Fire Department has not formally established specific objectives for any of these sub-components and records only the combined turnout and travel time for the first arriving vehicle (regardless of type).

As was mentioned, the detection time is an uncontrollable aspect of the service delivery model. For alarm processing and turnout time, the literature indicated that a maximum of one

minute was an acceptable objective for each of these activities. Therefore, an objective of performing each of these activities in less than one minute, 90% of the time is appropriate for the Hamilton Fire Department.

With regards to establishing objectives for response time, several considerations must be made. Since it is generally accepted that the first arriving piece of apparatus should be at the emergency scene within five minutes of sounding the alarm, then an appropriate objective for travel time is three minutes. Once the recommendations for alarm processing and turnout time are considered, then a recommended response time objective for the first arriving pumper would be "arrival on scene within five minutes of the receipt of the alarm, 90% of the time".

It is also recommended that the entire first-alarm response assignment be on the scene within approximately eight minutes of the receipt of the alarm. This equates to approximately six minutes of running time. However, a second pumper unit should arrive shortly after the arrival of the first pumper and before the remaining units if the successful intervention is to occur before flashover. To this end, it is recommended that the travel time for the second arriving pumper be four and one-half minutes, and six minutes for the remaining units. Once the alarm processing and turnout time are included, then a recommended response time for the second arriving pumper is "arrival on the scene within six and one-half minutes of the receipt of the alarm, 90% of the time". Similarly, a recommended response time for rescue and aerial units would be "arrival on the scene within eight minutes, 90% of the time".

Difficulties with the present method for dispatching Fire Department resources to medical emergencies prevent the achievement of the recommended response objectives. Under the present system, the services of the Fire Department are requested through the ambulance dispatch centre, often several minutes after the original call for assistance was received. Even

with the strategic location of Fire Department resources, it is extremely difficult to reach the scene of a medical emergency within acceptable time frames due to the delays inherent within the dispatching process.

In respect to the number of personnel and apparatus and equipment sent to each emergency, the second and third key elements of the service delivery model, the following observations were made. While the literature recommended that pumpers, aerials, and rescue units be staffed with a minimum of four personnel each, the current staffing practices of the Hamilton Fire Department are within acceptable guidelines and consistent with other comparable cities. In terms of the total number of personnel that are sent to both fire and EMS calls, a total of 15 personnel for fire calls and four for EMS calls is appropriate. Lastly, the practice of dispatching two pumpers, one ladder, one rescue, and a Chief Officer are also consistent with recommended guidelines. At the present time, there is not a defined objective with regards to the *capacity* of the Department.

The Hamilton Fire Department endeavors to remain current with regards to the last two elements of the service delivery model, *the level of training* and *the methods used*. Certainly, training is a priority activity for the Suppression Division as personnel endeavor to refine their skills and keep pace with industry practices. However, the training function could be further improved through the adoption of a more competency-based approach. An enhancement to the current level of medical training provided to all firefighters will also improve the effectiveness of Hamilton Fire Department personnel in the delivery of emergency medical services.

RECOMMENDATIONS

As was previously stated, the problem that this applied research project attempted to address was the lack of a comprehensive quality management process in the Hamilton Fire Department that will allow the Department to continuously evaluate itself and constantly strive for performance improvement. From this definition of the problem, the purpose of this applied research project was to utilize a quality management approach to establish an appropriate level of service for the Suppression Division of the Hamilton Fire Department.

As a result of this applied research project, the following recommendations will help to establish an appropriate level of service and improve the effectiveness of the Suppression Division:

1. **The Department should formally establish objectives for all aspects of the service delivery system.** The Department has historically endeavored to have an average response time of less than five minutes, which it consistently achieves. However, it was recognized that an average response time might not be the most appropriate performance measure and a 90% coverage objective is recommended. Therefore, it is recommended that the following objectives be adopted:

Response Time Elements	Objective	Total Response Time
Alarm Processing Time	90% ≤ 1.0 minutes	
Turnout Time	90% ≤ 1.0 minutes	
Travel Time:		
1st arriving pumper	90% ≤ 3.0 minutes	**90% £ 5.0 minutes**
2nd arriving pumper	90% ≤ 4.5 minutes	**90% £ 6.5 minutes**
Rescue & aerial units	90% ≤ 6.0 minutes	**90% £ 8.0 minutes**

As a further delineation of the level of service, it should also be expressly stated that the mandate of the Department is to conduct an aggressive interior attack of structure fires with a minimum of 15 personnel arriving at the scene of the emergency within the above time

frames. With regards to the delivery of Emergency Medical Services, it is the objective of the Department to arrive at the scene of all Code 4 (life-threatening) emergencies 90% ≤ 5.0 minutes to initiate Basic Life Support and early defibrillation.

2. **The Department should also further express its objectives with regards to the "capacity" of the Department**. Given the existing level of resources within the Hamilton Fire Department, it is recommended that the Department should be capable of simultaneously managing a 5-3 and a 5-2 alarm, while at the same time maintaining sufficient resources to provide an effective first response to any additional emergencies that may arise.
3. **The decision to undertake any new initiatives should be evaluated according to their impact on the aforementioned objectives for the Suppression Division.** For example, a thorough analysis of the impact of assuming a greater role in the delivery of land ambulance services should be undertaken to ascertain its effect on performance objectives. From this perspective, only those initiatives that contribute to an improvement in system performance should be considered.
4. **The Department should expedite the acquisition of a computer-aided dispatch system to assist in the evaluation of system performance.** At the present time, the Department does not have the sophistication to track and monitor each of the response time components that was described in Recommendation #2. Without the necessary management reports, it is difficult to provide those interventions that will help to optimize the level of system performance.
5. **The Department should continue to promote the benefits of smoke detectors and automatic sprinkler systems.** The early detection and suppression of fires through the use of smoke detectors and sprinkler systems can be an effective tool in fighting fires. Research

has shown that the state of the fire when detected is a preeminent factor in determining property and life loss. These initiatives will also serve to minimize the "detection" component of the response time element.

6. **The adoption of competency-based training, "benchmarking", and the continuation of post-incident analyses will help to maintain the effectiveness of the "level of training" and "methods employed" elements of the service delivery system.**
7. **System performance should be monitored on an on-going basis. Once the current level of service is thoroughly analyzed, then the appropriate interventions can be undertaken. System performance should be re-evaluated after the intervention has been completed.**
8. **Finally, a quality assurance committee with representation from each Division in the Hamilton Fire Department should be implemented.** Appropriate terms of reference should be established for this committee so that every aspect that affects service delivery is monitored and evaluated.

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APPENDIX #1
Fire Department Survey

Surveyed Members of the Metropolitan Fire Chiefs Association

Canadian	**US**
Calgary	Atlanta
Edmonton	Baltimore
Halifax	Birmingham
London	Boston
Mississauga	Buffalo
Montreal	Chicago
Ottawa	Cincinnati
Quebec	Cleveland
Scarborough	Dallas
Toronto	Detroit
Vancouver	El Paso
Windsor	Fairfax County
Winnipeg	Jacksonville
	Kansas City
n = 14	Los Angeles
	Louisville
	Memphis
	Metropolitan Dade
	Miami
	New York
	Oakland
	Oklahoma City
	Philadelphia
	Phoenix
	Pittsburgh
	Sacramento City
	San Antonio
	San Diego
	Seattle
	St. Louis
	St. Paul
	Tampa
	n = 32

Fire Department Survey

Department Name:_____

Contact Person:_____
Title and Name

Phone Number: (____)_____ **Fax #: (____)**_____

Total Number of Department Personnel:_____

Number of Personnel in Emergency Services Response:_____

1997 Operating Budget:_____

1997 Total Number of All Emergency Responses:_____

1. **Does your Department respond to both Fire and EMS incidents?**

   ☐ **Yes** ☐ **No**

2. **What percentage of your responses is EMS related?**

   ☐ **0 - 25%** ☐ **25 - 50%** ☐ **50 - 75%** ☐ **>75%**

3. **Have you established service level objectives?**

   ☐ **Yes** ☐ **No**

4. **If yes, are there separate objectives for Fire and EMS?**

   ☐ **Yes** ☐ **No**

5. **Are these objectives expressed as an average time or as a fractal number?**

   ☐ **Average** ☐ **Fractal**

6. **If objectives have been established, what are the objectives for:**

   First Arriving Pumper company:_____
   _____

   Second Arriving Pumper company:_____
   _____

   Ladder Company:_____
   _____

   Rescue Unit:_____
   _____

   Chief Officer:_____

_____

Other Responding Apparatus:

_____
_____
_____

7. What is the level of training of the firefighters providing EMS? (Check all that apply)

☐ **BLS** ☐ **ALS** ☐ **BTLS** ☐ **AED**

8. What is the staffing level for each response vehicle type?

Pump:_____positions

Rescue Unit:_____positions

Aerial / Ladder / Snorkel / Elevating Platform:_____positions

Other (specify_____):_____positions

Other (specify_____):_____positions

9. What is the number of vehicles and personnel that respond to each type of service request?

A. First alarm structure fire:

Vehicle Type	***# Responding***	***Total # of Personnel***
Pump(s)	_____	_____
Rescue Unit(s)	_____	_____
Aerial / Ladder / Snorkel / Elevating Platform(s)	_____	_____
Other: (specify_____)	_____	_____

B. Next level of alarm:

Vehicle Type	***# Responding***	***Total # of Personnel***
Pump(s)	_____	_____
Rescue Unit(s)	_____	_____
Aerial / Ladder / Snorkel / Elevating Platform(s)	_____	_____
Other: (specify_____)	_____	_____

C. EMS Responses:

Vehicle Type	*# Responding*	*Total # of Personnel*
Pump(s)	_____	_____
Rescue Unit(s)	_____	_____
Aerial / Ladder / Snorkel / Elevating Platform(s)	_____	_____
Other: (specify_____)	_____	_____

10. Do you have an established quality assurance process?

☐ **Yes** ☐ **No**

If yes, which components do you evaluate?

☐ **Time to process the alarm?**

☐ **Time for firefighters to mobilize?**

☐ **Travel time?**

☐ **Level of training of firefighters?**

☐ **Other Components (please specify)**
_____

☐ **Check here if you would like to receive a copy of the final survey results.**

Please forward the completed questionnaire by fax to:

Chief W.H. Shoemaker
Hamilton Fire Department
(905) 546-3344

APPENDIX #2
Summary of Survey Results

1. **Does your Department respond to both Fire and EMS incidents?**

   100% responded YES.

2. **What percentage of their responses is EMS related?**

   4% surveyed are 0-25%

   29% surveyed are 25-50%

   29% surveyed are 50-75%

   38% surveyed are >75%.

3. **Have they established service level objectives?**

   79% said YES

   21% said NO

4. **If yes, are there separate objectives for Fire and EMS?**

   46% said YES

   38% said NO

   16% did not respond

5. **Are these objectives expressed as an average time or as a fractal number?**

   38% said AVERAGE

   46% said FRACTAL

   21% did not respond

6. **If objectives have been established, what are the objectives for:**

   - **First Arriving Pump Company**
   - **Second Arriving Pump Company**
   - **Ladder Company**
   - **Rescue Unit**

- **Chief Officer**
- **Other Responding Apparatus.**

See Table 2 next page.

Table 2 – SERVICE LEVEL OBJECTIVES

DEPARTMENT	1ST ARRIVING PUMP CO.	2ND ARRIVING PUMP CO.	LADDER COMPANY	RESCUE UNIT	CHIEF OFFICER	OTHER APPARATUS
Atlanta	≤ 4 minutes, 60%	Not established	Not established	≤ 4 minutes, 60%	Not established	N/A
Boston	Tactical objectives only – no time components provided					
Buffalo	Tactical objectives only – no time components provided					
Detroit	--	--	--	--	--	ALS within 9 minutes, 90%
Edmonton	5 minutes average	--	--	--	--	--
Fairfax Co.	No established service level objectives					
Halifax	No established service level objectives					
London	No established service level objectives					
Memphis	No established service level objectives					
Miami-Dade	No established service level objectives					
Mississauga	4 minutes, 90%	6 minutes, 90%	8 minutes, 90%	8 minutes, 90%	--	--
Oakland	< 5 minutes average	< 8 minutes average	< 8 minutes average	--	--	--
Oklahoma	Tactical objectives only – no time components provided					
Ottawa	4.4 minutes average	N/A	N/A	N/A	N/A	N/A
Philadelphia	No time components provided					
Phoenix	Mean 3 minutes	Not established	Mean 5 minutes	(ambulance) 10 minutes, 90%	Mean 5 minutes	Not established
Pittsburgh	5 minutes from call receipt @ 911 centre, 90%	8 minutes from call receipt @ 911 centre, 90%	8 minutes from call receipt @ 911 centre, 90%	N/A	8 minutes from call receipt @ 911 centre, 90%	--
San Diego City	≤ 8 minutes, 90%	N/A	N/A	≤ 12 minutes, 90%	N/A	--
Seattle	< 5 minutes to structure fires, 85%	N/A	< 6.5 minutes to structure fires, 85%	N/A	N/A	ALS unit arrive < 9 minutes, 85%; BLS unit arrive < 5 minutes, 85%; HazMat/Marine/ TechRescue Teams arrive < 12 minutes
Tampa	5 minutes, 90%	Not established	Not established	6 minutes, 90%	Chief Officer's discretion	ARFF equipment to aircraft emergencies within 3 minutes
Toronto	4 minutes, 90%	8 minutes, 90%	8 minutes, 90%	8 minutes, 90%	8 minutes, 90%	--
Vancouver	< 4 minutes	< 6 minutes	< 6 minutes	--	--	--
Windsor	< 8 minutes average	< 8 minutes average	< 8 minutes average	< 8 minutes average	< 8 minutes average	< 8 minutes average
Winnipeg	Tactical objectives only – no time components provided					

7. What is the level of training of the firefighters providing EMS?

74% provide Basic Life Support (BLS)

52% provide ALS

26% provide BTLS

44% provide AED

8. What is the staffing level of each response vehicle type?

See Table 3 next page.

Table 3 – STAFFING LEVEL FOR RESPONSE VEHICLE TYPE

DEPARTMENT	PUMP	RESCUE UNIT	AERIAL LADDER	OTHER	OTHER
Atlanta	4	2	3	ARFF– 2	--
Boston	4	5	3	--	--
Buffalo	4	4	4	Chief– 1	Div Chief– 1
Detroit	4	4	4	Ambulance– 2	--
Edmonton	4	4	2	Chief Officer– 1	--
Fairfax Co.	4	3	3	ALS Trans– 2	BLS Trans– 2
Halifax	4	2	2	HazMat– 2	--
London	4	3	3	Command Car– 2	--
Memphis	4	4	4	EMS Units– 2	--
Miami-Dade	4	3	4	--	--
Mississauga	3-5	3-4	3-5	--	--
Oakland	4	N/A	4 on 4 Cos 5 on 3 Cos	--	--
Oklahoma City	4	4	4	Command Vehicle– 2	HazMat Unit– 4
Ottawa	4	3 Min 4 Norm	3	District Chief– 1	--
Philadelphia	4	2	5	HazMat– 11	Heavy Rescue– 6
Phoenix	4	2 (ambulance)	4	--	--
Pittsburgh	4	N/A	4	Quint– 5	Safety Unit-Pump – 4 Rapid Intervention Team– 4 Mobile Air Compressor Unit– 1
San Diego	4	2	4	Heavy Rescue– 4	--
Seattle	3 with 5 7 with 4 23 with 3	2 (AID unit)	8 with 5 3 with 4	Medic Unit– 2	Air Supply Unit (SCBA)– 1
Tampa	5	3	4	Ventilation Unit– 1	HazMat Unit– 6
Toronto	4	3-4	3-4	HazMat Unit– 3-4	--
Vancouver	4	3	3	--	--
Windsor	4	4	4	Chief's Car– 2	Emergency Supply Unit– 1
Winnipeg	4	4	2	--	--

9. What is the number of vehicles and personnel that respond to each type of service request?

A. First alarm structure fire:

See Table 4, next page

B. Next level of alarm:

See Table 5, page 44

C. EMS responses:

See Table 6, page 45

10. Do they have an established quality assurance process?

74% said YES

17% said NO

9% did not respond

If yes, which components do they evaluate?

70% Time to process the alarm.

44% Time for firefighters to mobilize.

61% Travel time.

52% Level of training of firefighters.

35% Other components.

30% Did not respond.

Table 4 – VEHICLE AND PERSONNEL RESPONSE FIRST ALARM STRUCTURE FIRE

DEPARTMENT	PUMPS		RESCUE UNITS		AERIAL/LADDER/ SNORKEL/ELEVATING PLATFORM		OTHER		TOTAL PERSONNEL
	Units	Personnel	Units	Personnel	Units	Personnel	Units	Personnel	
Atlanta	2	8	1	4	1	3	Comm Car (1) Air Unit (1)	2 1	18
Boston	3	12	1	5	2	8	Chief's Car (2)	4	29
Buffalo	3	12	1	4	2	8	Chief (1)	1	25
Detroit	3	12	1	4	1	4	Batt Chief (1)	1	21
Edmonton	2	8	1	4	1	2	Chief Officer (1)	1	15
Fairfax Co.	3	12	1	3	1	3	Batt Chief (1) EMS	1 1	20
Halifax	2	2-4+	1	2	1	2	--	--	6-8+
London	2	8	1	3	1	3	Command (1)	2	16
Memphis	2	8	--	--	1	4	BC (1)	1	13
Miami-Dade	3	12	1	3	--	--	Batt (1)	1	16
Mississauga	2	6-10	1	3-4	1	3-5	--	--	12-19
Oakland	2	8	--	--	1	4 or 5	--	--	13
Oklahoma	2	8	1	4	1	4	Command Veh (1)	2	18
Ottawa	2	8	0	0	1	3	District Chief (1)	1	12
Philadelphia	4	16	1	2	2	10	Batt Chief (2)	4	32
Phoenix	2	8	--	--	1	4	BC (1)	2	14
Pittsburgh	3	12	N/A	N/A	1	4	Chief (1)	1	17
San Diego	3	12	--	--	1	4	BC (1)	1	17
Seattle	3-5	10-21	1	2	2	8-10	Medic Unit (2) Air Support (1)	2 1	23-36
Tampa	3	9-12	1	2	2 High-rise 1 Normal	6-8 3-4	Chief (1) Res. Super Vent Truck	1 1 1	20-25
Toronto	2	8	1	3-4	1	3-4	District Chief	2	16-18
Vancouver	3	12	1	3	2	6	B/C (1)	1	22
Windsor	2	8	--	--	1	4	Chief (1)	2	14
Winnipeg	2	8	1	4	1	2	D/C (1)	2	16

Table 5 – VEHICLE AND PERSONNEL RESPONSE NEXT LEVEL OF ALARM

DEPARTMENT	PUMPS		RESCUE UNITS		AERIAL/LADDER/ SNORKEL/ELEVATING PLATFORM		OTHER		TOTAL PERSONNEL
	Units	Personnel	Units	Personnel	Units	Personnel	Units	Personnel	
Atlanta	3	12	1	4	2	6	Comm Car (1) Air Unit (1)	2 1	25
Boston	1	4	0	0	1	8	--	--	12
Buffalo	3	12	--	--	2	8	Chief (1)	1	21
Detroit	3	12	1	4	1	4	Batt Chief (1) Senior Chief (1)	1 1	22
Edmonton	2	8	1	4	1	2	Chief Officer (1)	1	15
Fairfax Co.	2	8	1	3	1	3	Batt Chief (1) EMS (2)	1 2	17
Halifax	Certain areas have automatic backup but emphasis is on the Officer to call for what is actually required								
London	As required								
Memphis	4	16	--	--	2	8	2	2	26
Miami-Dade	4	16	2	6	1	4	Batt (2)	2	28
Mississauga	2	6-10	--	--	1	3-5	Comm Post (1) Air/light (1)	1 1	11-17
Oakland	2	--	--	--	1	4 or 5	--	--	4 or 5
Oklahoma	2	8	1	4	1	4	Command Veh (2) Air Van (1)	4 1	21
Ottawa	4	16	1	4	2	6	District Chief (1) Platoon Chief (1) Safety Officer (1) On Call S/O (1)	1 1 1 1	30
Philadelphia	5	20	1	2	2	10	BN Chief (3)	6	38
Phoenix	4	16	--	--	2	8	BC (2)	4	28
Pittsburgh	2	8	--	--	1	4	--	--	12
San Diego	3	12	1	2	1	4	BC (1)	1	19
Seattle	3-4	10-15	0	0	2	8-10	Air Compressor (1)	3	21-28
Tampa	1	3-4	1	2	1	3-4	Chief (1) Rescue (1)	1 2	11-13
Toronto	4	16	1	3-4	2	6-8	District Chief (1) Platoon Chief (1)	2 2	29-32
Vancouver	3	12	--	--	2	6	--	--	18
Windsor	2	8	1	4	1	4	Chief (1)	2	18
Winnipeg	3	12	1	4	1	2	D/C (1)	2	20

Table 6 – VEHICLE AND PERSONNEL RESPONSE
EMS RESPONSE

DEPARTMENT	PUMPS		RESCUE UNITS		AERIAL/LADDER/ SNORKEL/ELEVATING PLATFORM		OTHER		TOTAL PERSONNEL
	Units	Personnel	Units	Personnel	Units	Personnel	Units	Personnel	
Atlanta	1	4	--	--	--	--	--	--	4
Boston	Boston EMS will dispatch 2 BLS units and 1 ALS unit to all confirmed fires								
Buffalo	1	4	--	--	--	--	--	--	4
Detroit	0	0	0	0	0	0	Ambulance (1)	2	2
Edmonton	1	4	--	--	--	--	Ambulance (1)	2	6
Fairfax Co.	1	4	--	--	--	--	EMS, ALS or BLS (2)	2	6
Halifax	1	2-4	1	2	--	--	--	--	4-6
London	1	4	--	--	--	--	--	--	4
Memphis	--	--	--	--	--	--	EMS (1)	2	2
Miami-Dade	1	4	1	3	--	--	EMD (varies)	--	7
Mississauga	1 or	3-4	1 or	3-4	1 or	3-4	--	--	3-4
Oakland	1	3	Or		1	4 or 5	--	--	3-5
Oklahoma	1	4	--	--	--	--	--	--	4
Ottawa	1	4	--	--	--	--	--	--	4
Philadelphia	1	4	1	2	1	5	--	--	11
Phoenix	1	4	--	--	--	--	--	--	2
Pittsburgh	--	--	1	2	--	--	--	--	6
San Diego	1	4	1	2	--	--	--	--	
Seattle	1	3-5	1	2	1	4-5	Medic Unit (1)	2	11-14
Tampa	1	3-4	1(on ALS call)	2	--	--	BLS Unit (1) (on BLS call)	2	5-6
Toronto	1 or	4	1 or	3-4	1 or	3-4	Hazard (1)	3-4	6-8
Vancouver	2	8	--	--	--	--	--	--	8
Windsor	1	4	--	--	--	--	--	--	4
Winnipeg	1	4	--	--	--	--	Ambulance ALS	2 2	8

APPENDIX #3
Fire Company Travel Time Standard

FIRE COMPANY TRAVEL TIME STANDARD

(Compatible With Fire Underwriters Survey Guidelines)

CLASS	RISK	FIRE STREAMS REQUIRED	MAXIMUM TRAVEL TIME					
			3.0 Min.	3.5 Min.	4.0 Min.	6.0 Min.	7.0 Min.	Total In 15 Min.
	Scattered small buildings in rural / semi-rural areas	2-3 (400-600 GPM)				P1		2P
2	Light detached residential; 1 or 2 storey buildings	4-5 (800-1000 GPM)			P1		P2	2P
3	Heavy residential development, including small apartment buildings *(2-4 storeys)*; light commercial including strip development	6-12 (1200-2400 GPM)		P1			P2,A1	1A,3P
4	Major commercial, institutional, shopping centres, apartments	13-20 (2600-4000 GPM)		P1,A1			P2,P3	2A,4P
5	Heavy commercial or industrial, multi-storeys	21-30 (4200-6000 GPM)	P1	A1	P2		P3,P4,A2	3A,6P
6	Severe hazards	> 30 (> 6000 GPM)	P1,A1	P2	P3,A2		P4,P5,A3	4A,8P

Key: P1.....P5 = 1st Pumper....5th Pumper
A1.....A3 = 1st Aerial....3rd Aerial
1 Fire Stream = 208 Imperial gallons per minute (1000 Lpm)