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Establishing a Fire Maintenance Shop for the Division of Fire Rescue

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CERTIFICATION STATEMENT

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

Signed: _____
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Abstract

The problem was that Frederick County Division of Fire Rescue did not have its own apparatus maintenance shop and relied on the County's general highway shop for mechanical maintenance and repairs. The purpose of this research was to identify how the Division of Fire Rescue could establish a fire maintenance shop, and what certifications were needed to properly and efficiently maintain their fire apparatus. Action research was used to answer the following questions: How do other municipal and volunteer fire departments maintain their apparatus? What types of certifications are required to work on fire apparatus and the consequences of not having certifications? What is the financial start-up impact of having our own fire mechanical shop? The procedure used to complete this applied research project consisted of literature review using articles, journals, and National Fire Protection Association (NFPA) Standards. Interviews were conducted with department heads, senior career and volunteer officers. A questionnaire was created and sent out to career, volunteer, and combination fire departments across the country. The recommendations included requiring all personnel working on fire apparatus, and supervisors, to become certified as Emergency Vehicle Technicians (EVT). Until pay grades appropriate for the level of EVTs are developed, and until personnel are certified, all repairs unique to fire apparatus to be contracted out to a qualified contractor.

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Introduction

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Any time a piece of emergency fire apparatus is involved in a significant accident, the first thing investigators will do is review the vehicle's maintenance records. Fire department officials and government leaders could encounter serious liability consequences for not having properly trained personnel repairing and maintaining their apparatus and emergency vehicles. In addition, during hard economic times, elected officials may elect to consolidate resources such as mechanical shops to reduce cost to the taxpayers.

According to Chief Gene Mellin, The Frederick County Division of Fire Rescue currently owns 117 emergency vehicles, including, pumpers, tankers, aerial trucks, ambulances and various types of support vehicles (personal communications, December 18, 2008). Each year, the Frederick County Board of County Commissioners approves the purchase of, on average, five to ten additional emergency vehicles, adding to the existing fleet. The problem is, as the Division of Fire Rescue's Fleet continues to grow, the Division of Fire Rescue does not have its own apparatus maintenance shop. It relies on the County's general highway mechanical shop for all maintenance and repairs.

The purpose of this research is to identify how the Division of Fire Rescue can establish a fire maintenance shop, and what certifications are needed to properly and efficiently maintain it's fire apparatus. Action research through literature reviews, personal interviews and questionnaires will be used to answer the following questions: (a) How do other municipal and volunteer fire departments maintain their apparatus? (b) What types of certifications are required in order for mechanics to be able to work on emergency apparatus, as well as the consequences

of not having said certifications? and (c) What is the financial start-up impact of having our own fire mechanical shop?

Background and Significance

The Frederick County Division of Fire Rescue has experienced rapid growth over the past five years. The Fire Rescue Service has attempted to keep up with the demands of the County's growth, which saw a 30% increase (discoverfrederickmd.com) between 1990 and 2000, exceeding all census projections. The growth within the fire service is directly related to the decline in volunteers, the increased need for service, and the cost of purchasing apparatus and constructing new fire stations. In addition to the personnel growth, the Division of Fire Rescue purchases, on average, five to ten new pieces of fire apparatus, ambulances and support vehicles each year to support this growth.

According to the United States Census Bureau, (United States Census Bureau, 2009) as of 2006, Frederick County, Maryland is comprised of 663 square miles, with a population of 222,938, and is experiencing tremendous growth on an annual basis. Frederick County is located in central Maryland, roughly an hour's drive from Washington, DC or Baltimore Maryland. The County has 30 Fire/Rescue/EMS stations operating out of 26 individually incorporated Volunteer Fire/Rescue or EMS Companies. Frederick County has approximately 900 volunteers working to provide either operational, administrative or fund raising assistance to their companies, and there are 383 career firefighters assigned to the various fire stations to augment those volunteers. When the volunteer response rate falls below the county's minimum response criteria of a 10% response-fail rate, career staff are then assigned to that station. They may be assigned to a station that has twenty-four hour per day coverage, or they may be assigned to a station that has coverage twelve hours per day, five days a week.

According to Chief Mellin, (personal communication, December 18, 2008) the fire companies in Frederick County respond to over twenty-four thousand calls for help each year, and that number grows by approximately ten percent each year.

Of the 30 Fire/Rescue/EMS Stations in Frederick County, three are County-owned and operated. The remaining 27 stations are owned by the volunteer Fire/Rescue/EMS Corporations. There are currently 283 Fire/Rescue/EMS and support emergency vehicles of various types in Frederick County. The County owns 117 of these emergency vehicles and they are assigned to the various fire stations within the County, according to Chief Mellin (personal communication, December 18, 2008). The remaining vehicles are owned by volunteer fire companies and are not necessarily maintained by the County's Fleet Department, but the County does provides funding for their vehicle maintenance expenses.

Each year, through the Frederick County budget process, the volunteer corporations are permitted to submit a request for new or replacement fire apparatus to be purchased by the County. These requests are reviewed by senior staff of the Division of Fire Rescue, and recommended for approval by the Board of County Commissioners. Vehicles that are purchased by the County must be in accordance with adopted standards for apparatus purchased using funds from the fire tax districts. The paint colors are standardized white over red, and all graphics are standardized. Each fire/rescue/EMS Company is allowed to submit a budget to the Board of County Commissioners for their operational expenses, which includes vehicle maintenance and repairs. The Board of County Commissioners requires all vehicles owned by the County to be maintained by the County's Fleet Services Division. In addition, fire apparatus, ambulances and other emergency vehicles owned by the volunteer fire companies, within Frederick City limits, are required to be maintained by Fleet Services. The maintenance regulation is written this way,

since the Board of County Commissioners provides funds for these repairs. All other fire/rescue/EMS Companies in the County may select their own repair facility to repair their vehicles using money appropriated to them by the Board of County Commissioners for vehicle repairs.

The County's Fleet Services Division is responsible for the maintenance and repair of all County-owned vehicles and equipment. The Fleet Services maintenance shop is divided into two sections. The first section is known as the large vehicle shop that provides preventative maintenance and repairs to fire apparatus, ambulances, dump trucks, snow plows, graders, tractors and other general use type vehicles and equipment. The second section is known as the small vehicle shop, which repairs vehicles such as staff cars, medic units and chief/duty vehicles.

Frederick County's Fleet Services Division has three mechanics who primarily work on fire apparatus and ambulances. According to Pat Hannah, Director, the mechanics maintaining and repairing the fire apparatus, ambulances and other emergency vehicles are not certified at the Emergency Vehicle Technician (EVT) levels, but have completed some EVT testing and are ASE certified (personal communications, December 18, 2008). Currently there are no requirements for the mechanics working on fire apparatus, ambulances or other emergency vehicles, or their supervisors, to be certified as Emergency Vehicle Technicians.

The purpose of this report is to satisfy the applied research project requirement for the *Executive Leadership* course of the National Fire Academy's Executive Fire Officer Program. This project relates to the fifth objective of the United States Fire Administration operational objective, responding appropriately in a timely manner to emerging issues. It is the responsibility of the Fire Chief to ensure that firefighters have the necessary training and tools to protect themselves, as well as the citizens they serve, and it is the role of the Executive Fire

Officer to develop, implement and follow through with the Department's goals and objectives for success.

Literature Review

There has been much written about how fire departments maintain their apparatus and the degree of training and certification their mechanics are required to have. This literature review was organized around three specific research questions that were being researched: (a) How do other municipal and volunteer fire departments maintain their fire apparatus? (b) What types of certifications are required for mechanics who work on emergency apparatus, and what are the consequences of not having said certifications? and (c) What is the financial advantage/disadvantage of having our own fire mechanical shop?

Over the past several years there have been many changes to the fire apparatus Frederick County buys. In addition to the changes in the components of the vehicles, there are changes to the laws and standards that govern these vehicles. "These trends are going to shape the future of fire apparatus, and their effects are both good and bad." (Cavette, 2006, p. 1). These changes will provide apparatus that is safer, more effective, and less harmful to the environment. These changes will also result in apparatus that is more expensive and more difficult to maintain.

"Significant technological advances made in the fire apparatus have placed greater demands on maintenance and repair personnel" (Fire Engineering, October 2000, p. 1). Electronics have become a major part of fire apparatus and ambulances. Computers control functions such as fuel, electrical, valves, pumps and braking systems, to name a few. "A simple generator or alternator, with a ammeter, to charge the vehicle batteries has the added element of load management to increase engine rpm and reduce unneeded loads during periods of battery

discharge." (Fire Engineering, October 2000, p. 1). In addition, "multiplexing" (Fire Engineering, October 2000, p. 1) is widely used. Multiplexing, "allows the various computers to communicate with each other over a single pair of wires to control such functions as interlocks and turning electrical accessories on and off" (Fire Engineering, October 2000, p. 1).

"All of these advancements have contributed to safer apparatus and have decreased the reliance on the human element to operate, but they have also made maintenance and repair functions more complex. It is safe to say that the days of the 'shade tree mechanic' repairing apparatus with a test light and a pair of cutting pliers are gone" (Fire Engineering, October 2000, p. 1). Diagnosing problems have become more sophisticated and the equipment required, such as computers and software, to identify problems has become more complex and expensive. The days of the mechanically-inclined fire fighters in the station to make general repairs are gone.

"Fire apparatus is a compilation of several extensive and detailed systems comprised of a power plant, hydraulic systems, pneumatic systems, water pumping system, and a very complex electronic system. Mechanics must continually use their knowledge and experience to repair each system on several different makes of apparatus" (St. Louis Fire Department Repair Shop, 2007, p.1).

There are several ways most jurisdictions may elect to have their apparatus preventive maintenance or repairs done. According to an article published in Fire Engineering the following methods are identified:

1. An outside repair facility or apparatus dealer is paid to maintain the apparatus. Using the apparatus manufacturers repair facility or a private contractor specializing in fire apparatus will most likely result in a well-maintained vehicle. The benefits of having experience in working on one particular brand of apparatus, or of seeing a common

problem surface numerous times are invaluable, and can reduce downtime significantly. The disadvantage here is that labor costs or maintaining larger fleets could be quite sizable.

2. The fire department maintains a shop facility and addresses some of the routine work. A shop facility under the direct control of the fire department would be an excellent way to maintain the apparatus. Budget, personnel schedules, maintenance intervals, parts inventory, and technician training can all be monitored and adjusted for best results. Obviously, though, the cost of wages, benefits, and facility maintenance must be considered.
3. The municipal garage maintains the apparatus, along with ambulances, police cars, and garbage trucks. In many cases, the fire department has no control over preventative maintenance scheduling and apparatus repair. Without control of the funds being allocated and spent on vehicle maintenance, the fire department generally will have little input into parts inventory, wages, or the amount of overtime allotted to the mechanics. The same is true for sending mechanics to seminars and training courses. Apparatus could be competing for shop space and mechanics' time with the snowplows and police cruisers. According to Fire Engineering (Fire Engineering, October 2000, p. 1), "there are some excellent municipal shops that have dedicated fire mechanics and place a high priority on fire apparatus repair, but the comments relative to local public works shops are generally poor" (Fire Engineering, October 2000, p.1).

Research for this literature review has revealed the many different ways fire departments maintain their apparatus, and how they use their repair facilities. The manner in which departments have their apparatus maintained varies, depending upon their size and from where they obtain funding.

The mission of the St. Louis Fire Department repair shop is "to provide apparatus maintenance and all the Support Services needed for the Fire Department" (St. Louis Fire Department Repair Shop, 2007, p.1). Their maintenance shop provides a preventative maintenance program and repairs for fire suppression apparatus and medic units. In addition, the repair shop also maintains the generators, Hurst extrication equipment, rescue saws, water pumps and other specialized fire suppression equipment. The fire fighters from the St. Louis Fire Department repair shop will respond with a Mobile Command Post to all major incidents the fire department responds to. They also respond with an air truck, a heavy wrecker, and a bus to relieve the firefighters from the weather, and to also bring needed supplies. The Support Services, which is part of the repair shop, is responsible for ordering and issuing supplies as needed for the fire departments.

The Toledo fire department has their apparatus maintained by the City of Toledo according to John Coleman, Chief of Operations, (Fire Engineering, October 2000). Coleman (2000) goes on to say, the repair shop of the Toledo Fire Department is also responsible to developing their own specifications and purchase of apparatus. Certified mechanics are employees of the City's maintenance bureau. These certified mechanics work for the City's maintenance bureau and are paid from the maintenance bureau's budget. They are under the direction of a non-fire department supervisor who works with the chief assigned to EMS and maintenance. Expenses are charged directly back to the fire departments' budget.

The city of Seattle Washington Fire Department leases all of its apparatus from the City of Seattle Executive Service Department (ESD). As part of this agreement with ESD, preventative repairs and maintenance are included. Funding for maintenance and repair is built into the lease rates based on the history and type of apparatus or vehicle. According to Ronald Hiraki, Assistant Chief with the Seattle Washington Fire Department, "the ESD fire garage is staffed by a Fire Garage Supervisor, eight experienced auto mechanics and an automotive parts warehouser" (Fire Engineering, October 2000, p. 3). One of the mechanics staffs a service truck and travels from station to station to repair and service apparatus as needed. This prevents the need to travel to the garage, reducing downtime and cost.

The Dallas Texas Fire Department has its own fire maintenance facility. Their maintenance department performs preventative maintenance and repairs, operating out of an eighteen-bay garage dedicated to heavy apparatus. Additional bays are dedicated to light vehicles such as ambulances and chiefs' response vehicles. A division manager dedicated to the fire service fleet heads their maintenance division.

According to Leigh Hollins, Battalion Chief (Fire Engineering, October 2000), Cedar Hammock and Southern Manatee Fire Districts in Florida have a unique situation. They are actually two fire districts operating as one under an inter-local agreement. They have approximately 100 personnel and 10 volunteers operating 32 emergency vehicles. Each district has its own full-time mechanic. A deputy chief manages the maintenance division. Their budget is derived from tax revenues and impact fees. The department has full control over budgeting and spending for apparatus maintenance and repairs (Fire Engineering, October 2000).

The Kalamazoo Michigan fire department has their apparatus maintained under a competitive contract that is bid on an annual basis. (Fire Engineering, October 2000). The selection of the vendor is based on its qualifications and certifications.

According to Assistant Chief, Joseph A. Floyd Sr. of the Columbia South Carolina Fire Department and Frank C. Schaper, Chief of the St. Charles Missouri Fire Department, their apparatus is maintained by the City's Fleet Services. This service is a city-wide repair facility that maintains all of the city's vehicles. According to Assistant Chief Floyd, the budgets for repairs are based on the previous years' expenditures (Fire Engineering, October 2000). Both Chiefs note that while their systems work, they could be improved.

The Boston Fire Department suffered a tragic accident in January of 2009, when the brakes failed on a ladder truck, causing the truck to crash into an apartment building, killing the lieutenant riding in the officer's seat of the vehicle. According to the Boston Globe (Boston Globe, 2009), "…the Fire Department does not have a routine preventive maintenance program for the city's fire trucks". In addition, "The Fire Department has a maintenance division of 12 uniformed firefighters who rotate tires and fix broken lights, among other duties, but they are not licensed mechanics"(Drake, Slack, 2009, p. 1)

In Frederick County, Maryland the independent volunteer fire department corporations own some of the fire apparatus, while other apparatus is owned by the Frederick County Government. Independent corporations, with a few exceptions, have the ability to maintain their apparatus as they see fit. According to Chief Brent Harne, (personal communication, December 18, 2008) of the Middletown Volunteer Fire Company (MVFC), the county appropriates vehicle maintenance money to them from their annual budget, and they have the choice of selecting who is going to repair their apparatus. Most departments select a private contractor who specializes in fire

apparatus repairs. This works well, according to Chief Harne (personal communications, December 18, 2008) as they only call when repairs are needed, preventative maintenance service is due, or when Department of Transportation (DOT) inspections are required. The down side to this method is, the MVFC is at the mercy of the contractor. The mechanic may not be available when immediate repairs are needed.

Apparatus and other vehicles that are owned by Frederick County are maintained by the County's Fleet Services Department. They have three mechanics in the large vehicle shop that work primarily on fire apparatus and ambulances. The smaller vehicles, such as staff and command cars, are maintained by the Fleet Services small-vehicle shop. The small-vehicle shop also works on all other County owned vehicles such as Animal Control, Parks & Recreations, Department of Public Works, etc.

The Fleet Services Department for Frederick County consists of 29 employees, including a Director, an Assistant Director, four Administrative Personnel, a Service Manager –Large Vehicles, a Service Manager-Small Vehicle, a Lead Vehicle Technician, two Inventory Specialists and sixteen mechanics that work on a variety of vehicles and equipment. Their mechanics work on dump trucks, snow plows, tractors, fire apparatus and other heavy equipment such as Gradalls, graders, and loaders. According to Pat Hannah, Director of Fleet Services (personal communications, December 18, 2008), the Fleet Services Department provides mechanics that are on call 24 hours per day. The mechanics on call provides service to all of the County's vehicle fleet and not specifically to Fire/Rescue. The Shop Supervisor produces a monthly maintenance schedule for preventative maintenance and repairs, as needed. According to Hannah (personal communications, December 18, 2008) "although there are three mechanics

who work primarily on fire apparatus and ambulances, there are sixteen other mechanics available to help if needed".

Money for vehicle maintenance and repairs are budgeted within each fire department's budget. Those budgets are then charged for the maintenance and repairs.

A survey (Appendix A) of volunteer, career and combination fire departments across the country identified only 46% of the departments that responded to the questionnaire have their own fire maintenance shop. In addition, only 38% of the respondents indicate their shop is solely dedicated to the fire departments apparatus and vehicles.

A standard is defined as "the type, model, or example commonly or generally accepted or adhered to; criterion set for usages or practices, a level of excellence, attainment, etc. regarded as a measure of adequacy" (Webster's Dictionary, Second College Edition, 1978, p. 1387). A guideline is defined as "a standard or principle by which to make a judgment or determine a policy or course of action". (Webster's Dictionary, Second College Edition, 1978, p. 621).

Whether or not standards are voluntary or mandatory, fire departments must consider the liability for failure to comply. "Even in states that protect rescue workers under an immunity statute, most state laws do not protect fire rescue departments for grossly negligent acts" (Murphy, 2009, p. 2). "Essentially, negligence involves the violation of a standard of care that results in injury or loss to some other individual or organization" (Murphy, 2009, p. 2). Murphy goes on to say, "Standards are set, like policies are created, because there is a need to regulate behavior and to provide a safe operating environment" (Murphy, 2009, p. 2).

The National Fire Protection Association (NFPA) has developed many standards for the fire service. "Although most NFPA standards are not laws, they are widely accepted industry standards with considerable legal standing" (Murphy, 2009, p. 1). "Failure to comply with them

can potentially put fire departments and manufacturers in serious liability." (Murphy, 2009, p. 1) According to Murphy, NFPA Standards "…are consensus standards developed by specific industries to set forth widely-accepted standards of care and operations for certain practices. Standards are an attempt by the industry or profession to self-regulate by establishing minimal operating, performance, or safety standards, and they establish a recognized standard of care. They are written by consensus committees composed of industry representatives and other affected parties" (Murphy, 2005, p. 1). Murphy goes on to say, "The standards should be followed to protect fire and rescue personnel from unnecessary workplace hazards and because they establish the standard of care that may be used in civil lawsuits against fire and rescue departments" (Murphy, 2005, p. 1).

Many of the standards that apply to the fire service directly relate to fire apparatus and other emergency vehicles. These standards apply to: the construction of apparatus, the safety of the firefighters and personnel maintaining these vehicles, the certification levels of personnel performing maintenance and repairs, and the inspection, maintenance and repair of the apparatus.

NFPA 1071, is the Standard for Emergency Vehicle Technician Professional Qualifications. NFPA 1911 covers the Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus. These standards are for the repair and maintenance of fire apparatus and the personnel responsible for maintaining the fire apparatus and vehicles.

NFPA 1071 was first drafted in July 1995 at the request of the International Association of Fire Chiefs. This standard establishes the minimum job performance requirements for a person qualified as an emergency vehicle technician who is engaged in the inspection, diagnosis, maintenance, repair, and testing of an emergency response vehicle. NFPA section 1071.3.3.20

Qualified Person, defines a qualified person as “A person, who by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training and experience, has demonstrated the ability to deal with problems relating to a particular subject matter, work, or project.” (NFPA 1071, 2006, p. 7). This is a requirement for all levels of an Emergency Vehicle Technician.

NFPA 1071 Annex A-Explanatory Material is not part of the requirements for this standard but is for informational purposes, and serves to help further explain some of the requirements. Section A.1.1 of this Annex states, “There are certain components on emergency response vehicles that are not considered unique” (NFPA 1071, 2006, p. 22). It is not the intent of this document to restrict the authority having jurisdiction from using persons they feel are qualified to perform inspections, diagnosis, maintenance, repair and testing of those components. However, an emergency response vehicle is a complex piece of machinery and there are main components that are highly integrated (e.g., the engine, transmission, and pump with electronic lockups and interlocks, remote engine controls, multiplexing, special cooling considerations). Because of this complexity, this document requires that a person qualified as an emergency vehicle technician possess minimum skills and knowledge to inspect, diagnose and perform repairs” (NFPA 1071, Annex A1.1, 2006, p. 22). In addition “Certain tasks are generic to all motor vehicles and can be performed by persons considered qualified by the authority having jurisdiction” (NFPA 1071, Annex A1.1., 2006, p. 22).

NFPA 1911 is a standard for Inspection, Maintenance, Testing and Retirement of In-Service Automotive Fire Apparatus. This standard combined three standards, NFPA 1911 Standard for Service Test of Fire Pump Systems on Fire Apparatus; NFPA 1914 Standard for testing Fire Department Aerial Devices; and NFPA 1915 Standard for Fire Apparatus Preventive

Maintenance Program, into a single document. This standard defines the minimum requirements for establishing an inspection, maintenance and testing program for in-service fire apparatus (NFPA 1911 1.1). "The primary purpose of this standard is to provide requirements for inspection, maintenance and testing programs that will ensure that in-service fire apparatus are serviced and maintained to keep them in safe operating condition and ready for response at all times" (NFPA 1911, 2007, p. 7.). This standard covers the complex parts of fire apparatus, whether it is part of the aerial device or the pumps on a pumper. These are the areas of fire apparatus that are unique compared to general truck maintenance and repairs.

NFPA 1071.3.3.10 (NFPA 1071, 2006) defines the different levels of an EVT as:

> 1071.3.3.10.1 Emergency Vehicle Technician (EVT) I - An individual who performs inspections, maintenance, and operational testing activities on emergency response vehicles and who, by possession of a recognized certificate, professional standing, or skill, has acquired the knowledge, training, and experience and has demonstrated the ability to deal with issues related to the subject matter, the work or the project.
>
> 1071.3.3.10.2 Emergency Vehicle Technician (EVT) II. An individual who performs inspection, diagnosis, maintenance, repair, and testing activities on emergency response vehicles and who by possession of a recognized certificate, professional standing, or skill, has acquired the knowledge, training, and experience and has demonstrated the ability to deal with issues related to the subject matter, the work or the project. The only difference in

responsibility between a EVT-I and a EVT-II is the ability to make the necessary repairs.

1071.3.3.10.3 Emergency Vehicle Technician (EVT) III. An individual who is the first level supervisor "leadman" responsible for Emergency Vehicle Technician I and II personnel performance, scheduling, quality control of repairs and performance, scheduling, quality control, of repairs and maintenance of work, and compiling and reviewing of initial documentation. This individual can also perform inspection, diagnosis, maintenance, repair and testing activities on emergency response vehicles and has, by possession of a recognized certificate, professional standing, or skill, acquired the knowledge, training and experience and demonstrated the ability to deal with issues related to the subject matter, the work, or the project.

NFPA 1071, Standard for Emergency Vehicle Technician Professional Qualifications "establishes a set of professional qualifications that can be used to develop educational requirements and corresponding certifications for emergency vehicle technicians and mechanics" (Emergency Vehicle Safety Initiative, 2006). Table 1 shows the different exams required for the EVT certifications for fire apparatus. Table 2 shows the different exams required for the EVT certifications for ambulance. Technicians who receive all of the EVT and ASE certifications are recognized as a master certified EVT.

Table 1
Emergency Vehicle Technician Fire Apparatus Certifications

Fire Apparatus Technician Level Requirement – Level I

ASE Exams:	EVT Exams:
T-7 or A-7, Heating and Air Conditioning T-2 Truck, Diesel Engines T-4 Truck, Brakes T-5 Truck, Suspension and Steering	F2 Design & Performance Standards and Preventative Maintenance of Fire Apparatus

Fire Apparatus Technician Level Requirements – Level II

ASE Exams:	EVT Exams:
T-3 Truck, Drive Train T-6 Truck, Electrical Systems	F3 Fire Pumps and Accessories F4 Fire Apparatus Electrical Systems

Fire Apparatus Technician Level Requirements – Level III

ASE Exams:	EVT Exams:
T-1 Truck, Gasoline Engines	F5 Aerial Fire Apparatus F6 Allison Automatic Transmissions

Table 2
Emergency Vehicle Technician Ambulance Certifications

Ambulance Technician Level Requirements – Level I

ASE Exams:	EVT Exams:
A-4 Automobile, Suspension & Steering A-5 Automobile, Brakes A-6 Automobile, Electrical Systems A-8 Automobile Engine Performance	E-1 Design & Performance and Preventative Maintenance of Ambulances

Ambulance Technician Level Requirements – Level II

ASE Exams:	EVT Exams:
A-1 Automobile, Engine Repairs A-3 Automobile, Manual Drive Train & Axle A-7 Automobile, Heating and A/C T-2 Truck, Diesel Engines	E-2 Ambulance Electrical Systems E-3 Ambulance Heating, Ventilation and A/C

Ambulance Technician Level Requirements – Level III

ASE Exams:	EVT Exams:
A-2 Automobile, Automatic Transmission And Transaxle T-4 Truck, Brakes T-5 Truck, Suspension and Steering	E-4 Ambulance Cab, Chassis & Body

A survey (Appendix A) was sent to volunteer, career and combination fire departments across the country, asking what levels of certification their departments require of their mechanics in order to work on fire apparatus and vehicles. Thirty nine percent of those responding stated that they require their mechanics to be completely certified as an Emergency Vehicle Technician (EVT). Thirty two percent required some EVT certifications.

The survey further asked what levels of certification were required of their maintenance supervisors. Twenty six percent of those responding indicated they required their maintenance supervisors to be fully certified as an EVT. Forty three percent required their supervisors to be ASE Certified at the Masters Level. The complete findings of this questionnaire can be found in Appendix A.

In addition to the benefits of having mechanics certified as EVTs, there are other applicable NFPA Standards that the typical shop mechanic may not understand. One standard in particular is NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program.* Section 4-1 states "Fire Department Vehicles" clearly spells out that the vehicle must be specified, designed and constructed with the safety of the firefighters in mind. Its acquisition, operation, maintenance, inspection and repair must always consider the health and safety of the user." (Henry, 2003, ch. 1, p. 11). NFPA 1500, Section 4-4 covers Inspection, Maintenance, and Repair of Fire Apparatus, sets out all the standards that must be in place for fire apparatus to be properly maintained and repaired.

Another concern for the mechanics is contamination by blood-borne pathogens. NFPA 1500, Section 4-7 specifies that all emergency vehicles must be decontaminated to satisfy NFPA 1581, *Standard on Fire Department Infection Control Program*. "If a vehicle is not properly decontaminated before repairs start, blood-borne pathogens can infect the technicians by entering the body through the eyes or other mucous membranes" (Henry, 2003, ch. 1, p. 11). "The blood-borne pathogens that are of particular concern are HIV and hepatitis A, B, and C" (Henry, 2003). The technicians and mechanics should be vaccinated for these types of contaminations. The normal shop mechanic would not be familiar with these NFPA Standards, potentially placing them at risk.

The cost benefit of having your own maintenance shop is dependant on the size of your department. "A shop facility under the direct control of the fire department can be a great way to maintain the apparatus. Budget, personnel schedules, maintenance intervals, parts inventory, and technician training can all be monitored and adjusted for best results. Obviously, the cost of wages, benefits, and facility maintenance must be considered" (Fire Engineering, October 2000, p. 1). A small volunteer fire department may not have the benefit of going to a municipal fire apparatus mechanical shop, and will contract their work out to an independent contractor. The Middletown Volunteer Fire Company is a small volunteer fire company that has eight different types of fire apparatus and emergency vehicles. According to Chief Brent Harne (personal communications, December 18, 2008) they contract their mechanical work out to an independent contractor and are utilized when there is scheduled preventative maintenance and repairs that need to be done. The contractor comes to the fire station to perform general maintenance and repairs, and based on the problem with the vehicle, he may select to take the vehicle to his shop (personal communications, December 18, 2008).

The complexity of fire apparatus has placed greater demand on maintenance and repair personnel. Advancement over the years has resulted in safer apparatus and decreased reliance on human element to operate. "Diagnosing problems in these systems requires specialized computer readers with the proper software and, more important, a "technicians" approach" (fire engineering, October 2000, p. 1). The cost of equipment for diagnosing problems has made the idea of smaller to mid-sized fire departments having their own mechanical shops less desirable. Many times it much more cost effective to contract these types of repairs to outside contractors.

When a municipal garage maintains the apparatus, "in many cases, the fire department has no control over preventive maintenance scheduling and apparatus repair" (fire engineering,

October 2000, p. 1). This article goes on to say, “without control of the funds being allocated and spent on vehicle maintenance, the fire department will have little input into the parts inventory, wages, or amount of overtime paid to the mechanics” (fire engineering, October 2000, p. 1). This holds true for training. Fire apparatus may compete for garage space with the dump trucks and police vehicles.

A survey was completed (Appendix A) asking, “Is your apparatus maintenance shop a separate building or included with another maintenance shop such as general use type vehicles?” Of the 135 fire departments that responded to this question, 40% indicated they have their fleet maintenance shop in a separate building. All others are included with their general vehicle maintenance.

Procedures

Definition of Terms

ASE – Automotive Service Excellence – Generally accepted standard for mechanics performing maintenance and repairs to vehicles.

EVT – Emergency Vehicle Technician. A Certification established under NFPA Standard 1071 for personnel maintaining fire apparatus and ambulances.

Fire Apparatus – A vehicle designed to be used under emergency conditions to transport personnel and equipment, and to support the suppression of fires and mitigation of other hazardous situations.

The procedures used to begin this study started with the Learning Resource Center (LRC) at the National Training Center. Information was obtained directly from other fire rescue departments as to how they maintain their apparatus and vehicles, as well as the certifications

their personnel are required to have. In addition, a search for past Applied Research Projects (ARP) on this subject was done at the LRC that provided several projects related to this topic in some form. Additional information in the form of articles was retrieved from various magazines, including Fire Chief and Fire Engineering Magazines. Other studies and information were obtained by doing on-line searches about maintaining fire apparatus and the required certifications.

Several standards from the National Fire Protection Association were obtained and reviewed that are related to the topic of this ARP. These standards were, NFPA 1071 *Standard for Emergency Vehicle Technician Professional Qualifications*, NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program*, NFPA 1901 *Standard for Automotive Fire Apparatus* and NFPA 1911 *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus*. These standards were reviewed and documented to show how they affect the maintenance of fire apparatus and vehicles. In addition, these standards addressed the levels of certifications that have been adopted in order for mechanics to adequately maintain fire apparatus and other vehicles.

This led to a personal interview with Chief Brent Harne of the Middletown Volunteer Fire Company. During this interview, the questions that were asked of him were: How does the Middletown Volunteer Fire Company maintain their apparatus? How is their maintenance program funded? And what are the positives and negatives of maintaining their vehicles in this manner? A personal interview was also conducted with Pat Hannah, Director of Fleet Services for Frederick County. He was asked to define the organizational structure of the fleet maintenance shop for Frederick County. In addition, he was asked about the number of mechanics they have on staff, how the mechanics that handle the fire apparatus maintain the

apparatus and other emergency vehicles, and what the required level of certifications are to maintain and repair fire apparatus and ambulances.

A questionnaire was developed and sent out to three different groups of people. The questionnaire (Appendix A) was sent out to Chiefs within the National Capital Region of Washington D.C. and members of the National Society of Executive Fire Officers. The questionnaire was also sent through TRADENET, a training resource and data exchange program that is used to exchange fire-related training information and resources among federal, state and local governments. TRADENET was used to receive additional input in relation to the topic of this ARP. The questionnaire was developed to determine what methods other fire departments use to maintain their apparatus and vehicles, the type of facility they have, what levels of certification and education are required of their mechanics and supervisors, how their maintenance programs are funded, and demographics about their departments. There were thirteen questions in all that were asked. All required a specific response and they were asked if they would provide the names of their departments in closing. The questionnaire received a total of 135 responses. The questionnaire and results are listed in Appendix A. Departments that responded to the questionnaire are listed in Appendix B.

Limitations

One of the limitations in doing this research about maintenance programs was trying to find actual information about the financial start-up impact. Most of the departments that were researched already had long-standing maintenance programs and shops. There was very little information available for this subject.

There are limitations with any questionnaires. First of all, researchers expect to receive a higher rate of returns than they actually receive. Another limitation was the reluctance of the

owner of the mailing list for the Chiefs within the National Capital Region to mail this questionnaire out. Some of the fire departments answering the questionnaire did not post their department's name and so, may not be reflected in the list of questionnaire participants.

The research method used for this research was action. Different articles and studies, as well as interviews and questionnaires, were used to assist in this research. The literature and journals that were retrieved were an excellent source of information, and also helped the researcher understand more of the different methods departments use to maintain their apparatus and vehicles, as well as the required certifications and the consequences of not having those certifications. The interviews with Chief Harne and Director Hannah were also an excellent source of information.

Results

The literature review, along with interviews and questionnaires that were completed for this applied research project, provided some good and useful material that assisted the researcher in answering the following questions. The research identified how different departments are structured to maintain their apparatus, what levels of certifications are required in order to properly maintain their apparatus, and what the consequences are for not having the required certifications. And finally, it revealed the financial impact of establishing a fire apparatus maintenance shop.

The first question asked was, "How do other municipal and volunteer fire departments maintain their apparatus? Research found that "Days of the "shade tree mechanic" repairing apparatus with a test light and a pair of cutting pliers are gone." (Fire Engineering, October 2000, p. 1). Repairing fire apparatus and ambulances have become more and more of a challenge. Over the last several years, there have been many changes to the fire apparatus we purchase,

making them more difficult to maintain. This is a result of the many changes to the laws and standards that govern these vehicles. The good part is, these changes will provide apparatus that are safer and less harmful to the environment. The bad part is, they are expensive to purchase, expensive to maintain, and more difficult to maintain.

Electronics has become a major part of fire apparatus and ambulances. Computers control functions such as fuel, electrical, valves, pumps and braking systems, to name a few. This, along with multiplexing, which allows computers within the apparatus to communicate with each other through a single wire, makes these vehicles very complex and requires specialized training to understand and repair. "Fire apparatus is a compilation of several extensive and detailed systems comprised of a power plant, hydraulic systems, pneumatic systems, water pumping systems, and a very complex electronic system". "Mechanics must continually use their knowledge and experience to repair each system on several different makes of apparatus." (St. Louis Fire Department Repair Shop, 2007). Diagnosing problems have become more sophisticated and the equipment required, such as computers and software, have become more complex and expensive.

With these new advances, fire departments, both career and volunteer must look at different ways to maintain their apparatus. The manner in which fire apparatus and ambulances are maintained will vary, depending on the size of the fire department. Smaller departments may find the equipment needed to diagnose and repair these vehicles are too expensive and elect to contract this work to a qualified contractor. According to an article published in Fire Engineering (Fire Engineering, October, 2000) the following methods are identified:

1. An outside repair facility or apparatus dealer is paid to maintain the apparatus. Using the apparatus manufacturer's repair facility or a private contractor specializing

in fire apparatus will probably result in a well-maintained vehicle. The benefits of having experience in working on one particular brand of apparatus or of seeing a common problem surface numerous times are invaluable and can reduce downtime significantly. The disadvantage here is that labor costs of maintaining larger fleets could be quite sizable.

2. The fire department maintains a shop facility and addresses some of the routine work. A shop facility under the direct control of the fire department can be a great way to maintain the apparatus. Budget, personnel schedules, maintenance intervals, parts inventory, and technician training can all be monitored and adjusted for best results. Obviously, the cost of wages, benefits, and facility maintenance must be considered.
3. The municipal garage maintains the apparatus along with "ambulances, cop cars, and garbage trucks" (Fire Engineering, October 2000, p.2). In many cases, the fire department has no control over preventative maintenance scheduling and apparatus repair. Without control of the funds being allocated and spent on vehicle maintenance, the fire department generally will have little input into the parts inventory, wages or amount of overtime to the mechanics. The same is true for sending mechanics to seminars and training courses. Apparatus could be competing for shop space and mechanics time with the snowplows and police cruisers. According to Fire Engineering "there are some excellent municipal shops that have dedicated fire mechanics and place a high priority on fire apparatus repair, but the comments relative to local public works shops are generally poor" (Fire Engineering, October 2000, p. 2).

Smaller fire departments such as the Middletown Volunteer Fire Company choose to contract their apparatus maintenance out to a contractor. This works well according to Chief Brent Harne, (personal communications, December 18, 2008) of the Middletown Volunteer Fire Company. They can select who they would like to maintain their apparatus, and according to Chief Harne, "we only call when repairs are needed, preventative maintenance service is due, or for Department of Transportation (DOT) required inspections" (personal communications, December 18, 2008).

This research has found that there really is no right or wrong way of establishing a maintenance shop. In a larger department such as the St. Louis Fire Department, their maintenance personnel will respond to large incidents to provide support. In addition, they will also respond with an air truck and a heavy duty wrecker. Their Support Services is included as part of their maintenance shop. The St. Louis repair shop also works on their small tools such as generators, saws, Hurst extrication equipment, and portable water pumps.

The maintenance shop for the Toledo Fire Department is also responsible for developing their specifications for the purchase of apparatus. The Kalamazoo Michigan fire department contracts their repairs to an outside-qualified vendor.

Researching this question revealed that fire departments maintain their apparatus based on the size of their departments and how their maintenance is funded. It is not feasible for the smaller departments, mostly the small volunteer fire departments, to have their own maintenance shops. Typically, they take care of small repairs such as light bulb replacements, and some volunteer departments may even have the luxury of having a qualified mechanic as a volunteer that may assist with their maintenance.

There are exceptions though, such as a volunteer fire department that responded to the survey for this ARP (Appendix A). Their Chief Engineer, who is a retired Electromechanical Engineer, is assisted by another volunteer who was previously the Chief of Maintenance for the Lakehurst, New Jersey Naval Station. Together they handle their department maintenance. In addition they are assisted by several other professional mechanics. They perform preventative maintenance on their apparatus in station, and outsource their pump and aerial certifications, major repairs, and inspections to a firm that is ASE-Master and EVT certified because of liability concerns.

Departments with larger fleets typically have some form of a maintenance shop. But the level of maintenance may vary, depending on the size of the department and the certifications of their mechanics. Departments without properly certified mechanics may choose to perform some preventative maintenance of their apparatus such as brake work and some drive train work. When they do not have certified mechanics, they will send their vehicles out to a qualified repair facility to perform maintenance on items such as pumps, aerials, or specialized electronics for fire apparatus.

The Fleet Repair Shop in Frederick County is a countywide repair facility with three mechanics designated to work on fire apparatus. These mechanics receive supervision by a Lead Vehicle Technician and a Shop Service Manager. Two of the three mechanics have some certifications as an EVT, and the third is a Master Automotive Service Excellence (ASE) Mechanic. These mechanics work on all parts of the fire apparatus and ambulances. Other mechanics in the shop will help perform general preventative maintenance and minor repairs as needed. The County's Fleet Shop is responsible for the maintenance of all County-owned fire

apparatus, ambulances and support vehicles. In addition, the Fleet Shop is responsible for all other County vehicles and equipment such as snowplows, tractors, loaders and graders,

A survey (Appendix A) was sent out to volunteer; career and combination fire departments across the country, and of the departments that responded to the survey, only 46% indicated that they have their own fleet maintenance shop. The remaining 54% either contract out for these services or perform their maintenance in-house.

The second research question asked, "What type of certification is required for mechanics to hold in order to work on emergency apparatus and what are the consequences of not having these certifications?" A standard is defined as "the type, model, or example commonly or generally accepted or adhered to; criterion set for usages or practices, a level of excellence, attainment etc, regarded as a measure of adequacy" (Webster's Dictionary, Second College Edition, 1978, p. 1387).

The National Fire Protections Association (NFPA) has developed many standards for the fire service. "Although most NFPA standards are not laws, they are widely accepted industry standards with legal standing. Failure to comply with them can potentially put fire departments and manufacturers in serious liability." (Cavette, 2005, p. 1) "NFPA standards are consensus standards developed by specific industries to set forth widely accepted standards of care and operations for certain practices" (Murphy, 2005, p. 1). These standards are necessary to protect fire and rescue personnel from unnecessary workplace hazards. They also serve to establish the standard of care that may be used in civil lawsuits against fire and rescue departments.

"NFPA 1071, *Standard for Emergency Vehicle Technician Professional Qualifications,* is to identify the minimum job performance requirements for a person to be qualified as an Emergency Vehicle Technician (EVT). The purpose of the standard is to ensure that personnel

who are engaged in the inspection, diagnosis, maintenance, repair, and testing of emergency response vehicles are qualified". (Henry, 2003, ch 1, p. 4).

NFPA 1071 defines personnel who are qualified to work on emergency fire apparatus and vehicles. They are identified in three different levels, i.e. EVT-I, EVT-II and EVT-III. NFPA 1071.3.3.20 defines a qualified person as "A person, who by possession of a recognized degree, certificate, professional standing or skill, and who, by knowledge, training and experience, has demonstrated the ability to deal with problems relating to a particular subject matter, work, or project" (NFPA 1071, 2006). This is required for all levels of an EVT.

NFPA 1071 Annex A is an explanatory document that says there are certain components on emergency response vehicles that are not considered unique. It is not the attempt of this standard to prevent persons who are qualified from performing inspections, diagnoses, maintenance, repairs, or testing on these components. However, components that are unique to fire apparatus and other emergency vehicles such as engines and transmissions with lockups and interlocks, remote engine controls, multiplexing, pumps, and aerial devices requires a qualified person such as an EVT to inspect, diagnose and perform repairs.

An individual that is certified as a EVT-I is someone who performs inspections, maintenance, and operational testing activities on emergency response vehicles; has a recognized certificate, professional standing or skill; has acquired the requisite knowledge, training and experience; and has demonstrated the ability to handle related issues on the subject. An EVT-II has the same requirements as an EVT-I, and in addition is responsible for performing repairs. An EVT-III is the first level of supervision and is responsible for the EVT-I and EVT-II. In addition to the supervisory functions, this position has all the requirements of an EVT-II, and is responsible for scheduling, quality control and record keeping.

The survey (Appendix A) that was sent out to volunteer, career, and combination fire departments across the country indicated that only 39% of those responding required their mechanics to be completely certified as an EVT at any level, and 32% of those responding indicated they required some EVT certifications. The survey also indicated that only 26% of the responding departments required their supervisors to be fully certified as an EVT at any level. Forty-three (43%) percent required their supervisors to be ASE certified at the Masters Level.

There are several other NFPA Standards that affect the personnel who work on fire apparatus and emergency vehicles. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*. This standard provides for the safety of firefighters as it relates to the vehicles they operate. It also addresses their workplace safety, including hearing and eye protection. Additionally, this standard should be taken into consideration when determining specifications for apparatus and mounting equipment; when determining the driver/operators role in safely transporting personnel, and the number of persons riding in the apparatus; and in determining the inspections and maintenance of the apparatus.

In addition NFPA 1500 addresses the concerns of blood-borne pathogens and how they can contaminate mechanics. The blood borne pathogens of most concern are HIV and hepatitis A, B and C. The typical shop mechanic would not be familiar with these NFPA standards and wouldn't have the proper training to work on the unique components of the fire apparatus.

The final research question asked, "What is the financial start-up impact of having our own fire mechanical shop?" The most difficult part of establishing a fire maintenance shop is finding qualified personnel to work on fire apparatus and emergency vehicles. Mechanics with EVT certifications are difficult to find and hire. Other considerations for the initial start-up of a

maintenance shop would be the cost of equipment such as vehicle lifts, and any diagnostic tools necessary for identifying mechanical problems.

When a maintenance shop is under the control of a fire department, the fire department controls the budgets, personnel schedules, maintenance intervals, parts inventory, and training; and a maintenance shop under the control of a municipal garage would have little control over the expenses or scheduling of apparatus repairs. In many cases the fire department would be competing for space with other municipal vehicles.

Establishing a shop may not be the most cost effective method of maintaining fire apparatus. Smaller fire departments will find it more cost effective to contract their repair needs out to a qualified mechanical contractor. This would eliminate the necessity of hiring qualified mechanics and of purchasing the equipment needed to maintain the vehicles. A benefit of having a contractor who specializes in fire apparatus repair is that he may recognize a common problem sooner, lessening the cost and down time of an apparatus. More often, it is much more cost effective to contract these types of repairs to outside qualified contractors.

Researching this topic revealed that there are many different ways to establish a maintenance shop and program. It is determined, basically, on what best fits your department financially and operationally. The survey that was completed for this research revealed that only 46% of the respondents have their own maintenance shop, 38% are strictly dedicated to fire and rescue, and 40% have their shop in a separate building.

This purpose of this research was to identify how the Division of Fire Rescue in Frederick County could establish its own fire maintenance shop. Currently, Frederick County has their fire apparatus and ambulances maintained under the control of Frederick County's Fleet Services Division, where there are three fire mechanics primarily responsible for working on fire

apparatus. These mechanics and their supervisors are presently lacking the proper EVT certifications. This research has identified the need to develop a new policy stating that, until mechanics and supervisors are certified in the proper EVT designations, any inspection, diagnosis or repair to parts of any vehicle unique to fire apparatus will be contracted out to a qualified contractor.

Discussion

"Significant technological advances made in the fire apparatus have placed greater demands on maintenance and repair personnel" (Fire Engineering, October 2000, p. 1). "All of these advancements have contributed to safer apparatus and have decreased the reliance on the human element to operate, but they have also made maintenance and repair functions more complex. It is safe to say the days of the 'shade tree mechanic' repairing apparatus with a test light and a pair of cutting pliers are gone" (Fire Engineering, October 2000, p. 1).

Fire departments maintain their apparatus in ways that best suit their needs. That is expected of any responsible fire department. This research identified that there is really no right or wrong way to establish a maintenance program, but that there is a right and wrong way to select the mechanics to perform those duties.

The fire apparatus and emergency vehicles in Frederick County are maintained by the County's Fleet Services Division. The Fleet Services Division, in addition to maintaining fire apparatus and emergency vehicles, are responsible for the snowplows, dump trucks, tractors, graders, etc. The Division of Fire Rescue is required to have all the County-owned vehicles maintained by Fleet Services, and has no input into the maintenance budgets, the training of the personnel working on the vehicles, or the maintenance schedules. The supervisors or personnel

working on the fire apparatus and emergency vehicles are not certified as EVT's, and have completed only a few of the tests.

Fire apparatus and emergency vehicles that are owned by the various volunteer fire companies within the County are appropriated funds for vehicle maintenance, and are able to select qualified mechanical contractors of their choice for their maintenance.

One of the alternatives this research identified for the maintenance of apparatus maintenance is to have an outside repair facility under contract to maintain these vehicles. Another is to have a fire department shop that is run strictly by the fire department, and a third is to maintain a municipal garage to maintain all municipal vehicles. There are advantages and disadvantages to each of these methods.

This research identified how the duties and responsibilities of maintaining apparatus vary from department to department. For smaller fire departments, it's quite simple. Most fire departments do not have the financial and tangible resources to have their own fleet shop. It is much more cost effective to outsource this work to a qualified contractor. The larger municipal fire departments may choose to establish its own maintenance shop that is strictly dedicated to fire apparatus, and other departments may choose to have their apparatus and emergency vehicles maintained by a municipal garage that provides maintenance to other municipally-owned vehicles. A department having its own fleet repair facility has the advantage of having control over personnel, budgets, training and scheduling of their preventative maintenance and repairs. When a department is required to maintain their vehicles through a municipal garage, they are at the mercy of an outside department. They have little or no control over the personnel working on the apparatus and the costs associated with maintaining those vehicles, even though they are paid for through the fire department's budget.

One of the biggest concerns related to the maintenance of fire apparatus and emergency vehicles is employing qualified personnel to perform those functions. It became evident in this research that many governmental and fire departmental leaders are exposing themselves to significant legal risks because they do not use qualified mechanics to perform their maintenance. The survey (Appendix A) indicated that only 39% of the departments that responded use Emergency Vehicle Technicians with all of the certifications. Even more troublesome, the survey revealed that only 29% of maintenance shop supervisors are completely certified as an EVT. NFPA has placed standards such as NFPA 1071 to protect fire and rescue personnel from unnecessary workplace hazards, and those standards establish the standard of care that may be used in civil lawsuits against fire and rescue departments. "The purpose of the standard is to ensure that personnel who are engaged in the inspection, diagnosis, maintenance, repair and testing of emergency response vehicles are qualified" (Henry, 2003, ch., p. 4).

The Boston Fire Department suffered a tragic accident, January 2009, when a ladder truck returning from a call lost control on a hill, after the brakes failed, and crashed into an apartment building, killing the lieutenant riding on the apparatus. According to the Boston Globe, it "appears to confirm what fire officials suspected: the brakes failed as the truck barreled down a street in Mission Hill" (Drake, Slack, 2009, p. 1). The Boston Fire Department's maintenance division consisted of 12 uniformed firefighters who rotated tires and fixed broken lights but were not licensed mechanics. "The Fire Department does not have a routine preventive maintenance program for the city's fire trucks" (Drake, Slack, 2009, p. 1). This was a tragic accident that was most likely completely avoidable, and will be tied up in the legal system for quite sometime. There are many departments across the country that could be faced with a similar situation

because of the lack of properly qualified mechanics and supervisors working on fire apparatus and emergency vehicles.

What this research did identify is the requirements of the personnel maintaining these vehicles. NFPA has developed standards over the years for the qualifications of the personnel who are maintaining these vehicles. Table 1 and Table 2 illustrates the requirements of certification at the different EVT levels, and at the Master EVT level.

Fleet maintenance departments who do not have qualified personnel to maintain their fire apparatus and emergency vehicles should seek to contract the work out that is unique to fire apparatus. Some municipal departments such as Frederick County's Fleet Services Division is reluctant to send this type of work out to a qualified contractor, even though, it is clearly stated in NFPA 1071 what levels of work can be performed by a ASE certified mechanic and an EVT.

The financial impact of forming a fire apparatus maintenance shop is difficult to evaluate. In addition to purchasing the necessary equipment such as lifts and diagnostics tools, the primary expense lies in the hiring of certified mechanics to perform the repairs. The complexity of fire apparatus has placed a greater demand on maintenance and repair personnel. "Diagnosing problems in these systems requires specialized computer readers with the proper software, more important, a "technicians" approach" (Fire Engineering, October 2000, p. 1). Many times it is much more cost effective to contract specialized work out to a qualified contractor than to try and make the repairs in-house, especially when you do not have qualified personnel. When a municipal garage maintains the apparatus, "in many cases, the fire department has no control over the preventive maintenance scheduling and apparatus repair" (Fire Engineering, October 2000, p. 1). In addition, "without control of the funds being allocated and spent on vehicle maintenance, the fire department will have little input into the parts inventory, wages, or amount

of overtime paid to the mechanics" (Fire Engineering, October 2000, p. 1). A survey that was completed (Appendix A) indicated that only 40% of those responding have their own fleet shop.

The decision of whether or not to establish a fleet shop is dependent on the needs of the fire department.

Recommendations

The reason this subject was selected as research topic is because the Division of Fire Rescue Services for Frederick County has their County-owned fire apparatus and emergency vehicles maintained by the County's Fleet Services Division. There have always been concerns, both in the area of mechanics and with regard to supervision, about whether proper maintenance is being performed, and whether qualified personnel are working on these vehicles.

This research has revealed that Frederick County does, in fact, have a good preventative maintenance program with adequate documentation of the repairs performed. All that is lacking are the qualifications of the personnel performing the repairs. While these mechanics are highly competent, they do not possess the necessary EVT certifications needed to perform repairs that are unique to fire apparatus and emergency vehicles, exposing Frederick County to significant liability. The Fleet Services mechanics are currently in the process of obtaining EVT certification.

Based on these findings, it is recommended that Frederick County's Fleet Services Division take the following action:

- Have mechanical personnel performing maintenance & repairs to fire apparatus and emergency vehicles become certified as Emergency Vehicle Technicians-II.
- Have personnel in a supervisory capacity become certified as Emergency Vehicle Technicians-III.

- Develop a pay grade specific to the Emergency Vehicle Technician Level above the level of a standard truck mechanic.
- Have all repairs that are unique to fire apparatus and emergency vehicles contracted out to a qualified contractor until mechanical personnel are certified at the appropriate Emergency Vehicle Technician level.

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Appendix A

Appendix A - Fire Apparatus Maintenance Shops

1. Does your Department have their own Fire Maintenance Shop?

	Response Percent	Response Count
Yes	45.9%	62
No	54.8%	74
answered question		135
skipped question		0

2. Is your maintenance shop dedicated to only Fire/Rescue emergency apparatus?

	Response Percent	Response Count
Yes	38.2%	47
No	61.8%	76
answered question		123
skipped question		12

3. Is your apparatus maintenance shop a separate building or included with another maintenance shop such as general use type vehicles?

	Response Percent	Response Count
Separate Building	39.7%	46
Included with other general vehicle maintenance	60.3%	70
answered question		116
skipped question		19

4. Is your maintenance budget funded by tax dollars or donations from outside sources (i.e. Volunteer Fire Department Fund Raising)?

	Response Percent	Response Count
Tax Dollars	99.2%	131
Other sources	1.5%	2
answered question		132
skipped question		3

5. What levels of certification does your emergency vehicle mechanics have? (Check all that apply)

	Response Percent	Response Count
Emergency Vehicle Technician Certification - Complete	38.8%	47
Emergency Vehicle Technician Certification - Some Certifications	32.2%	39
ASE Certified - Master Level	38.8%	47
ASE Certified - Some Certifications	38.8%	47
On the Job Training	38.0%	46
answered question		121
skipped question		14

6. What levels of education does your emergency vehicle mechanics have?

	Response Percent	Response Count
High School Graduate	51.7%	60
Trade School Graduate	52.6%	61
Some College	35.3%	41
2 Year Degree	7.8%	9
4 Year Degree	3.4%	4
Masters Degree	0.9%	1
answered question		116
skipped question		19

7. What levels of certification does your maintenance shop supervisors have?

	Response Percent	Response Count
Emergency Vehicle Technician Certification - Complete	28.6%	32
Emergency Vehicle Technician Certification - Some Certifications	20.5%	23
ASE Certified - Master Level	**42.9%**	**48**
ASE Certified - Some Certifications	20.5%	23
On the Job Training	34.8%	39
answered question		**112**
skipped question		**23**

8. What levels of education does your maintenance shop supervisors have?

	Response Percent	Response Count
High School Graduate	35.8%	39
Trade School Graduate	29.4%	32
Some College	**39.4%**	**43**
2 Year Degree	5.5%	6
4 Year Degree	9.2%	10
Masters Degree	2.8%	3
answered question		**109**
skipped question		**26**

9. How many pieces of apparatus does your department have?

	1-5	6-10	11-20	21-30	31-40	more than 41	Response Count
Fire Engines	**48.1% (65)**	28.1% (38)	11.9% (16)	3.7% (5)	2.2% (3)	6.7% (9)	135
Aerial Trucks	**83.3% (100)**	11.7% (14)	3.3% (4)	0.8% (1)	0.8% (1)	0.0% (0)	120
Tankers	**84.6% (55)**	10.8% (7)	3.1% (2)	0.0% (0)	0.0% (0)	1.5% (1)	65
Brush Trucks	**84.9% (73)**	7.0% (6)	5.8% (5)	0.0% (0)	1.2% (1)	1.2% (1)	86
Ambulances	**58.1% (43)**	23.0% (17)	12.2% (9)	1.4% (1)	2.7% (2)	2.7% (2)	74
Other Support Vehicles	**47.3% (61)**	31.0% (40)	11.6% (15)	3.9% (5)	2.3% (3)	4.7% (6)	129
						answered question	**135**
						skipped question	0

10. What is your maintenance budget?

	Response Percent	Response Count
$0 to $10,000	4.6%	6
$11,000 to $30,000	14.5%	19
$31,000 to $50,000	11.5%	15
$51,000 to $100,000	19.8%	26
$101,000 to $250,000	22.9%	30
Greater than $250,000	**26.7%**	**35**
	answered question	**131**
	skipped question	**4**

11. What type of department do you have?

	Response Percent	Response Count
Career	54.1%	72
Volunteer	7.5%	10
Combination Career/Volunteer	38.3%	51
answered question		133
skipped question		2

12. What are the number of incidents your department responds to on a annual basis?

	Response Percent	Response Count
Less than 500	7.4%	10
501 to 1,000 Incidents	7.4%	10
1,001 to 2,500 Incidents	17.0%	23
2,501 to 5,000 Incidents	24.4%	33
5,001 to 10,000 Incidents	16.3%	22
10,001 to 20,000 Incidents	13.3%	18
Greater than 20,000 Incidents	14.8%	20
answered question		135
skipped question		0

13. Option: Please provide the name and address of your department. This will only be used for this research project.

	Response Count
	93
answered question	93
skipped question	42

Appendix B

Appendix B - Departments Who Responded to Survey

	Comment Text	Response Date
1.	CFA, Victoria, Australia.	Thu, 1/15/09 4:47 PM
2.	Montgomery County Fire and Rescue Rockville, MD	Wed, 1/14/09 4:28 PM
3.	DeKalb County Fire Rescue 1950 West Exchange Place Tucker GA 30084	Wed, 1/14/09 12:55 PM
4.	Colerain Twp. Dept. of Fire & EMS 3251 Springdale Rd. Cincinnati, OH 45251-1502	Wed, 1/14/09 11:28 AM
5.	Lexington Division of Fire and Emergency Services 219 E. Third St. Lexington, KY 40508	Wed, 1/14/09 9:37 AM
6.	Northwest Fire District 5225 W. Massingale Road Tucson AZ 85743	Wed, 1/14/09 9:28 AM
7.	Peoria Fire & Rescue 505 N. Monroe St. Peoria, IL 61603	Tue, 1/13/09 2:51 PM
8.	Ithaca Fire Department 310 W. Green Street Ithaca, NY 14850	Tue, 1/13/09 2:34 PM
9.	Okolona Fire District 8501 Preston Highway Louisville, Ky. 40219 We only do minor maintenance in house, heavy maint. (pumps, engine work etc.) is contracted to outside vendor. Good Luck!!!	Tue, 1/13/09 2:00 PM
10.	Rudy Horist, Assistant Fire Chief Elgin Fire Department 550 Summit Street Elgin, IL 60120 Good luck with your ARP!	Tue, 1/13/09 1:48 PM
11.	Federal Heights Fire Department 2400 West 90th Ave. Federal Heights, CO 80260	Tue, 1/13/09 1:37 PM
12.	City of Palm Coast Fire Dept. 9 Corporate Dr. Palm Coast, FL 32164	Tue, 1/13/09 1:30 PM
13.	Memphis Fire Department 65 South Front Street Memphis, TN 38103	Tue, 1/13/09 1:01 PM
14.	James City County Fire/EMS 300 McLaws Circle, Suite # 200 Williamsburg, VA 23185	Tue, 1/13/09 12:33 PM
15.	Mooresville Fire Department Mooresville, NC	Tue, 1/13/09 12:11 PM
16.	Fresno Fire Department 911 H. Street Fresno, CA 93721	Tue, 1/13/09 11:52 AM
17.	Lynnwood Fire Department Lynnwood, Wa.	Tue, 1/13/09 11:39 AM
18.	City of Cape Coral, FL	Tue, 1/13/09 11:10 AM
19.	City of Dallas Oregon Fleet Maintenance - they service both Dallas Fire Department and Southwest Polk County Rural Fire Protection District apparatus	Tue, 1/13/09 11:06 AM
20.	City of Yuma Fire Department, One City Plaza Box 13013, Yuma, AZ 85366-3013	Tue, 1/13/09 10:20 AM
21.	Doug Hall - Deputy Fire Chief Westminster FD 9110 Yates St. Westminster, CO 80031	Tue, 1/13/09 10:18 AM
22.	Chief Daniel J. Gaumont, City of Watertown NY Fire-Rescue 224 S. Massey St Watertown, NY 13601	Tue, 1/13/09 10:15 AM
23.	Garland Fire Department 1500 East State Hwy 66 Garland, TX 75040	Tue, 1/13/09 10:09 AM

24.	Small issues by the captain in charge of maintenance- Shift commander not only assigned to maintenance. Large jobs sent to private contractors.	Tue, 1/13/09 9:52 AM
25.	Palm Coast Fire Department, Florida Our Mechanics are also line fire fighters. The supervisor is a Lt. the other a FF, they work out of a fire station.	Tue, 1/13/09 9:46 AM
26.	Flagstaff Fire Department 211 W. Aspen Ave Flagstaff, AZ. 86001	Tue, 1/13/09 9:44 AM
27.	Kingman Fire Department 412 Oak Street Kingman, Arizona 86401	Tue, 1/13/09 8:55 AM
28.	McHenry Township Fire Protection District 3610 W. Elm Street McHenry, IL 60050 (I would be interested in a copy of your finished research - Joe Krueger, Asst. Chief)	Tue, 1/13/09 8:39 AM
29.	Sedgwick County Fire Department 7750 N. Wild West Blvd, Park City KS 67147	Tue, 1/13/09 8:36 AM
30.	White River Township Fire District 850 S. Mullinix Road Greenwood, IN 46143	Tue, 1/13/09 8:30 AM
31.	Carrboro Fire-Rescue Department 301 West Main Street Carrboro, NC 27510	Tue, 1/13/09 8:02 AM
32.	Park Forest Fire Department 156 Indianwood Blvd. Park Forest IL 60466	Mon, 1/12/09 4:16 PM
33.	City of Gainesville Fire Rescue 1025 NE 13 Street Gainesville, Florida 32601	Mon, 1/12/09 8:10 AM
34.	Fort Lauderdale Fire-Rescue 528 NW 2 Street Fort Lauderdale, Florida 33311-9108	Sun, 1/11/09 7:52 PM
35.	Nevada County Consolidated Fire District 11329 McCourtney Road Grass Valley, CA. 95949	Sun, 1/11/09 6:50 PM
36.	Casa Grande Fire Department 3181 N. Lear Casa Grande, AZ 85222	Sun, 1/11/09 12:38 PM
37.	East Rutherford FD One Everett Place East Rutherford, NJ 07073	Fri, 1/9/09 10:26 PM
38.	Grand Rapids Fire Dept 38 LaGrave Grand Rapids, MI 49503	Fri, 1/9/09 8:45 PM
39.	Lealman Fire District DC Keirn 4360 55th Ave. N. St. Petersburg, FL 33714	Fri, 1/9/09 12:00 PM
40.	Mark Quick 142 Sheppard Dr. Durango, CO 81303	Fri, 1/9/09 10:40 AM
41.	Auburn Fire Division 161 North Ross Street Auburn, AL 36830 Lee Y. Lamar jr. Fire Chief 334-501-3162 llamar@auburnalabama.org	Fri, 1/9/09 10:01 AM
42.	Franklin Fire Department 109 3rd Avenue South Suite 133 Franklin, TN 37064 Contact: Capt. Joe Polenzani	Fri, 1/9/09 9:29 AM
43.	Liberty Missouri Fire Department 200 W. Mississippi St Liberty, MO 64068	Fri, 1/9/09 9:02 AM
44.	Salem Fire Department 260 S. Ellsworth Ave. Salem, OH 44460	Fri, 1/9/09 8:52 AM
45.	Captain Tony McDowell Henrico County Division of Fire 7721 East Parham Road Henrico, Virginia 23273	Fri, 1/9/09 8:50 AM
46.	Wadsworth Fire Dept. 153 N. Lyman St. Wadsworth, Ohio 44281	Fri, 1/9/09 8:34 AM

47.	Captain Douglas Stewart Delaware Fire 99 S. Liberty St Delaware, Ohio 43015 740-203-1300 (O) 740-225-9599 (C) Our maintenance budget is low because each department in the city that has vehicles pays into a garage rotary to offset the overall cost. We do the same thing with out IT. Our mechanics were not EVT until our new chief came in 3 years ago and pushed the issue. Call if you need more information. Good luck in EFO I am still trying to get in. Doug	Thu, 1/8/09 10:19 PM
48.	Colorado Springs Fire Department 375 Printers Parkway Colorado Springs, CO 80910	Thu, 1/8/09 9:49 PM
49.	Tukwila Fire Department 444 Andover Park East Tukwila, WA 98188 (206) 575-4404	Thu, 1/8/09 9:13 PM
50.	Blue Twp Fire-Rescue/Pottawatomie Co. Fire Dist. #5 3503 Scottie Lane Manhattan, KS 66502	Thu, 1/8/09 8:35 PM
51.	Hales Corners Fire Department 10000 W. Forest Home Avenue Hales Corners, Wisconsin 53130	Thu, 1/8/09 3:12 PM
52.	Lincoln Fire & Rescue 1801 Q St. Lincoln, NE 68508	Thu, 1/8/09 3:08 PM
53.	Las Cruces (NM) Fire Department PO Box 20000 Las Cruces, NM 88004	Thu, 1/8/09 2:58 PM
54.	Wauconda Fire District 109 West Liberty Street Wauconda, IL 60084	Thu, 1/8/09 2:51 PM
55.	Portland Maine FD 380 Congress St. Portland, ME. 04101	Thu, 1/8/09 2:40 PM
56.	Shelby Fire & Rescue 506 East Grover Street Shelby, NC 28150	Thu, 1/8/09 2:28 PM
57.	Citrus County Fire Rescue Florida	Thu, 1/8/09 2:25 PM
58.	Florissant Valley Fire Protection District 645 St. Catherine Street Florissant, MO. 63031	Thu, 1/8/09 1:08 PM
59.	Richfield Fire Department 6700 Portland Ave. Richfield, MN 55423	Thu, 1/8/09 1:06 PM
60.	Baytown FD 201 East Wye Drive Baytown, TX 77521-4130	Thu, 1/8/09 12:56 PM
61.	Haddon Heights Fire Department Haddon Heights New Jersey 08035	Thu, 1/8/09 12:33 PM
62.	City of White Plains, NY	Thu, 1/8/09 12:19 PM
63.	Wolfeboro, NH Fire-Rescue, PO Box 629, Wolfeboro, NH 03894. Routine maintenance performed by firefighters. Oil changes, chassis service by municipal mechanics (Public Works Dept), Pump and other specialized service by fire vehicle maintenance company located in area.	Thu, 1/8/09 11:54 AM
64.	We provide fire and rescue services only. EMS is provided by a separate agency.	Thu, 1/8/09 11:53 AM
65.	Hanford Fire Department 350 W. Grangeville Blvd. Hanford, CA 93230	Thu, 1/8/09 11:51 AM
66.	Commerce Township Fire Dept. 2401 Glengary Rd. Commerce Twp. MI 48382	Thu, 1/8/09 11:50 AM
67.	Paul Montavon Colerain Township Department of Fire & EMS 11865 Colerain Ave Cincinnati, Ohio 45252 (513) 245-5451 pmontavon@coleraintwp.org	Thu, 1/8/09 11:36 AM
68.	Watertown Fire Department, Watertown WI Hi Steve	Thu, 1/8/09 11:31 AM

69.	Eureka Fire Department 533 C St. Eureka, CA Our vehicle maintenance budget is actually part of a fleet lease agreement within our city. Our Corporation Yard does all maintenance on the vehicles and apparatus. They also "own" the apparatus, as the apparatus are owned by the City, and not the fire department. We have two Fire Mechanics at the Corp Yard who work on the fire apparatus (they also work on heavy equipment, such as trucks, tractors, etc). General mechanics work on the other support vehicles (sedans, pickups). They also provide fleet work for police, public works, etc.	Thu, 1/8/09 11:26 AM
70.	Eric Smith 533 C Street Eureka, Ca 95501 Note- maintenance amount includes fleet lease cost	Thu, 1/8/09 11:24 AM
71.	Williamsburg Township Emergency Services 915 W. Main St.	Thu, 1/8/09 11:14 AM
72.	Gresham Fire & Emergency Services, Gresham, OR NOTE: Our City Fleet Services does our Maintenance. Cannot readily pull our cost out of the total budget	Thu, 1/8/09 11:03 AM
73.	Sanbornton Fire Department PO Box 112 565 Sanborn Rd Sanbornton, NH 03269	Thu, 1/8/09 11:03 AM
74.	Greensboro Fire 1514 N Church St Greensboro, NC 27405	Thu, 1/8/09 10:59 AM
75.	Lackawanna Fire Department 1630 Abbott Road Lackawanna, NY 14218	Thu, 1/8/09 10:56 AM
76.	Our volunteer Chief Engineer has a Master's Degree in Electrical Engineering and retired from a 30 year career as and Electromechanical Engineer with IBM. He is assisted by another Volunteer with an MS in Engineering who was previously Chief of Maintenance for the Lakehurst, NJ Naval Station. Several other members who are professional mechanics assist. Our air systems are maintained by a Volunteer with a PhD in Aerospace Engineering who retired from GE where he headed turbine aircraft design. Our communications systems are managed by a retired Naval Captain. With all of that said, we outsource annual pump and ladder certifications for reasons of liability and also outsource semi-annual inspections and PM of all apparatus to a firm that uses ASE-Master and EVT (complete) personnel. All PM activity is conducted at our stations. Major work (we replaced two pumps in recent years) may be sent to outside shops. We know that we are unusual in this area! hope this helps.	Thu, 1/8/09 10:56 AM
77.	Cincinnati Fire Department 9542 East Kemper Road Loveland Ohio 45140	Thu, 1/8/09 10:44 AM
78.	City of Watertown NY Fire Department 224 S. Massey St. Watertown NY 13601	Thu, 1/8/09 10:28 AM
79.	MMM	Thu, 1/8/09 10:26 AM
80.	Jersey City Fire Dept. 715 Summit Ave jersey city NJ. 07306	Thu, 1/8/09 10:23 AM
81.	Fairfield Fire Department 1200 Kentucky St. Fairfield, CA. 94533	Thu, 1/8/09 10:17 AM
82.	Assistant Chief Brian McMahan Mukilteo (WA) Fire Department	Thu, 1/8/09 10:14 AM
83.	Hanover Park Fire Department 6850 Barrington Road Hanover Park, IL 60133	Thu, 1/8/09 10:12 AM
84.	Drexel Heights Fire District 5030 S. Camino Verde Tucson, AZ. 85735	Thu, 1/8/09 10:06 AM

85.	Our shop is an enterprise fund that services all of our apparatus listed above, plus that of the region. Vancouver Fire Department 7110 NE 63rd St Vancouver, WA 8661	Thu, 1/8/09 10:05 AM
86.	City of Erie, Bureau of Fire 626 State Street Erie, PA 16501	Thu, 1/8/09 10:03 AM
87.	Major maintenance is sent out too ASA or EVT Mechanics. Some of the small repairs ie. light bulbs water valves are completed in house by staff.	Thu, 1/8/09 10:03 AM
88.	All of our City maintenance is outsourced. I was unable to answer come of the survey questions properly because of this. For fire apparatus, I require everyone who works on the vehicles to be EVT and ASE Master as part of my maintenance bid. -Chief J.D. Mosby Byron (GA) Fire Department 478-956-3600	Thu, 1/8/09 10:02 AM
89.	John W. Payne Div. Chief/Fire Marshal 100 Millwood Cir. Maumelle, Ark. 72113	Thu, 1/8/09 9:53 AM
90.	John D. Johnston 1016 Columbus Ave Waco, Texas 76701	Thu, 1/8/09 9:50 AM
91.	CAL FIRE (California Department of Forestry and Fire Protection Nevada-Yuba-Placer Unit 13760 Lincoln Way Auburn CA 95603	Thu, 1/8/09 9:50 AM
92.	Hampden Township Volunteer Fire Company 295 South Sporting Hill Road Mechanicsburg, PA 17050	Thu, 1/8/09 9:44 AM
93.	Chief Derek Bergsten Rockford Fire Department 204 South First Street Rockford, Illinois 61104	Thu, 1/8/09 9:32 AM