District of Columbia
Fire and Emergency Medical Services Department

An Audit and Assessment of the
DC Fire and Emergency Medical Services Department's
Fleet Inventory and Fleet Maintenance Operations
to Further Improve Fleet Management

November 25, 2013

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SECTION 1. EXECUTIVE SUMMARY

This section summarizes the approach, findings, and recommendations of the audit.

1.1 Project Background and Overview

In July of 2013, Business Development Associates, LLC (BDA Global) – in association with TriData, a Division of System Planning Corporation (TriData), and Mercury Associates, Inc. (Mercury) – was retained by the District of Columbia to assess and audit the fleet management and maintenance functions of the District of Columbia Fire and Emergency Medical Services Department (FEMS). The objective of the review is to provide FEMS with an analysis and subsequent recommendations to improve internal business processes, fleet preparedness, practices and systems, and provide a detailed, up to date inventory in order to become more effective in supporting FEMS operations. The study was limited to specific areas within the Apparatus Division (AD).

The study entailed a major undertaking to identify, analyze, and report on the conditions of apparatus, use of facilities, and the deployment of resources to effectively manage FEMS' fleet. It also included significant findings and recommendations that are tailored to achieving and maintaining a fleet with state of the art capabilities into the long-term.

We would be remiss to not acknowledge steps that have been taken to modernize the fleet, including the recent acquisition of 30 new or refurbished apparatus, but caution that without systematic improvements to fleet operations, these apparatus too would be at risk of falling into disrepair in the future. It is, hence, important that FEMS prioritize recommendations for implementation and develop a Strategic Implementation Plan to define how and when additional improvements are made.

1.1.1 Purpose

Through this project, FEMS aims to gain a better understanding of the readiness of its fleet and its ability to respond to emergencies with trained and qualified personnel and a robust fleet that meets operational standards.

While there are many dedicated and hardworking individuals at the FEMS Shop, the purpose of this report is to focus on opportunities for improvement, as opposed to the positive aspects of FEMS' performance observed during our review. In this way, this engagement is not designed to provide "attaboys" for processes, practices, and procedures the Department already performs well; rather, the goal is to identify necessary improvements and recommended actions irrespective of whether they are already in process or will require Department approval for successful implementation.

1.1.2 Scope

This report includes a comprehensive assessment of the following major topics among other related subjects addressed as part of this audit:

- Fleet inventory, including current location, assignment, and existing condition of apparatus[1]
- Fleet maintenance and repair operations
- Vehicle records
- The FASTER fleet management information system (FMIS) application and its implementation, as well as a comparison of FASTER with other available fleet management software
- FEMS policies and procedures related to fleet operations
- The number of reserve apparatus needed to maintain operations, and a comparison of that number to the Department's plans for emergency mobilization
- Reserve apparatus processes
- Storage capacity for the FEMS fleet, comparing available space to required space
- Training and certification of fleet maintenance personnel and facilities
- The Department's apparatus specifications and specifications development processes to standardize the quality of specification with the industry standards
- Small tools repair and maintenance
- Per-unit costs for each class of apparatus and expected life cycle costs

Please note that this Executive Summary highlights the major themes of the report by subject area, but does address each of the 112 findings and 129 recommendations documented in this report. Please see the full report for detailed findings and recommendations, and Appendices V and VI for summarized findings and recommendations in tabular format.

1.1.3 Methodology

The study began in July 2013 with a Kick-off Conference involving the Project Team in the DC Office of Contracts and Procurement (OCP) with OCP and FEMS officials, including the Fire Chief. Project Team members conducted initial site visits to the FEMS Shop in July 2013, where they met with representatives from the Shop, became familiar with the Shop layout, and began interviews with Shop personnel. Starting in July and stretching into August, the Project Team

[1] Inventory assessment was not mechanical in focus and did not serve as a safety and maintenance inspection (see note 2 for further details)

then conducted a rigorous, time-intensive inventory of the entire FEMS fleet.[2] This audit also required that the team visit every fire station and division. Team members took the opportunity to interview and hold informal discussions with on-duty firefighters and EMS personnel during our visits. Over the subsequent two months, the Project Team made follow-up site visits to gather additional information and conduct additional interviews. Data and background information, budgetary information, and personnel staffing records were also collected and reviewed, and contact was made with other jurisdictions to obtain comparative information. Throughout the project, team members continued to review information collected from interviews and analyze data. The report was written between September and November of 2013.

1.1.4 Assumptions

The most important assumption for a report of this nature is that accurate data exist about the fleet and the dollar costs and labor time needed to maintain it. Without baseline data on fleet resources, it is extremely difficult to effectively analyze the fleet and to make recommendations with full confidence. While the audit identified deficiencies and mechanisms that are recommended to improve the current state of the AD operations, this study's scope of work did not include an analysis of FEMS' deployment of its resources or a detailed cost analysis. We took the current deployment as the baseline for our analysis and discussion of fleet management.

This study also assumes that the overall call volume would not change *significantly* – in terms of the rate of growth, the nature of the incidents (i.e., EMS versus fire), or the geographic distribution of the calls. We also assumed that the road surface and traffic conditions with which the FEMS vehicles and operators must contend on a daily basis would not change significantly. The study also assumed that the Department would quickly take delivery of the following recently ordered apparatus: 30 ambulances (six of which were refurbished apparatus that FEMS presently owns), six engines, two trucks, and a fire boat. Finally, some recommendations assume that the Department will undertake programmatic and operational changes intended to reduce the backlog of vehicles needing preventative maintenance (PM) and repair as well as the future overall demand for repair services. Recommendations for improvement may, therefore, have an impact in shaping the Department's budget process in subsequent years.

1.1.5 Report Organization

Following are brief descriptions of the major sections of this report.

[2] It is important to understand that the inventory was an exercise to verify FEMS' vehicle records against the physical apparatus located by the Project Team. The data generated on the condition of the apparatus did not represent an effort to grade each piece of apparatus according to objective and replicable criteria (Project Team members had neither the time nor the mechanic's training on heavy duty apparatus to be able to undertake such an effort); rather, these data were intended to be a rough, subjective estimate of the condition of each piece of apparatus based on Team members' experience operating and working from similar apparatus in other fire and EMS departments. This review is therefore a quantitative and qualitative assessment of the current status of the FEMS fleet and is not intended to serve or double as a safety and maintenance inspection.

SECTION 3 (Fleet Data Systems) – discusses the AD's use of the FASTER system and provides a comparative analysis of other fleet management information systems.

Section 4 (Fleet Composition) – discusses the composition and condition of the current fleet, reserve fleet requirements, and apparatus replacement.

Section 5 (Apparatus Division Operations) – provides an in-depth analysis of the operations of the Apparatus Division and makes recommendations for improvement.

Section 6 (Station-Based Operations) – discusses in-station operations and their impact on Apparatus Division operations.

Section 7 (Impact of ISO Rating Change) – discusses the potential impact of changing the District's Insurance Services Office rating.

1.1.6 Major Outcomes and Next Steps for Implementation

More than 100 major findings identified as part of this audit and assessment (see APPENDIX V) indicate a system that has been in disrepair for 15 to 20 years – significantly predating the current administration. A major outcome of this assessment has been to provide FEMS with options and recommendations for essential, short-term, medium-term, and strategic (long-term) improvements, which are based on industry best practices and benchmarking of comparable fleet departments (see APPENDIX IV).

It is important to note that FEMS, at the time of writing this report, has begun to take initial steps toward implementing selected operational improvements in the areas of Preventative Maintenance (PM), budgeting, and more strategic use of the FASTER system. Should FEMS implement other recommendations for operational enhancements, there would be significant impact on the operating budget henceforth. The need for a Strategic Implementation Plan is foremost and a precursor to implementing recommendations as described within the body of this report. A comprehensive cost analysis was not within the scope of this engagement yet would serve in conjunction with the development of a Strategic Implementation Plan to guide improvements, including a more detailed apparatus replacement plan, that are financially viable and cost-effective.

1.2 Summary of Major Project Findings

1.2.1 Fleet Data Systems

Having all pertinent transactional and management data consolidated in a single system and available to all fleet users provides an effective tool for day-to-day management of the operation, a basis for timely management decisions and an efficient information retrieval and reporting platform. FEMS utilizes Faster Asset Solutions' FASTER C/S as its FMIS. The system is recognized in the fleet industry as a reasonably priced second-tier system and is capable of providing all of the necessary functionality to manage a professional fleet operation.

FEMS has been using the FASTER FMIS for more than eight years. To date, the system has not been used to its maximum potential. Business processes are not optimized and are not mapped into the FMIS for support of day-to-day operations and data collection. The staff is not familiar with the benefits of management reporting, trend analysis or performance monitoring.

Users and management appear to believe that FASTER is not capable of supporting the FEMS maintenance and repair operation. The Project Team, however, found that the issues causing the apparently erroneous data stemmed primarily from incomplete operational procedures and processes, lack of consistent data capture standards, a misunderstanding of how the individual data elements provided detail for the overall management scheme and what management reports and performance indicators should be in place to monitor the overall operational status. Currently, there are few reports or performance indicators being used to manage the operation.

Vehicle statuses are not being effectively used to indicate the current snapshot of the FEMS inventory. Additionally, we observed that there are units removed from active service and awaiting disposal which have not been identified in FASTER as being out of service or pending property disposal. Vehicle locations and assignments are not updated or managed in FASTER, but were reported to be tracked in a separate spreadsheet. Likewise, units moving in and out of frontline and reserve service are not updated in FMIS. This prevents maintenance staff from properly identifying priorities and assessing readiness and downtime/availability. Work details and assignments have not been fully and effectively recorded in FASTER. This has prevented Shop management from being able to document and track the work currently in process or identify pending or current activities.

FASTER Service Center is a Web-based intranet access portal currently available to FEMS. It allows customers to reference historical maintenance and repair details about their assigned vehicles, monitor actual real-time work order statuses, report vehicle deficiencies, and request maintenance and repair appointments. This portal is not being used by staff or FEMS customers, and it seems that the functions and benefits of this module are unknown.

FASTER has the capability of capturing all aspects of an enterprise parts operation including parts inventory and parts processing tasks. Currently most of FASTER's parts capabilities are not being used by FEMS staff. Parts are not ordered or received through the application. Rather, parts are ordered outside of the system, and parts inventory quantities are manually adjusted when new parts are received. Reorder information and inventory minimum/maximum levels are not set in FASTER, which prevents using the auto-order report or auto-order function. Because part orders or receipts are not entered into FASTER, staff cannot tell whether parts have been ordered for a specific job awaiting parts or awaiting scheduling for repairs.

Overall, FEMS' current level of use of FASTER has been inefficient and inconsistent. FEMS is not following best practice expectations with regard to fleet information management. There is no doubt that there are more complex or higher-level FMIS applications than FASTER available

on the market. On the other hand, given FEMS' current data capture and work management practices, and the lack of management reporting and performance indicator requests, the quality and capabilities of FASTER *far exceed* FEMS' immediate needs and requirements to adequately manage its maintenance operation using industry-accepted best practices.

Irrespective of whether FEMS chooses to acquire a new FMIS or pursue configuration and reimplementation of FASTER, the Department must ensure that the core deficiency issues outlined in Sections 3.1 to 3.3 are corrected. Procuring a full-featured, robust fleet management system will not guarantee an effective solution *unless* the application is properly implemented, necessary data are properly entered, and the system is used consistently throughout the organization. Consistent use includes the capture of proper data and providing accurate management information and information transparency while satisfying daily best practice management procedures.

Many opportunities for improvement and recommended options have been identified to remedy the current issues using *FASTER C/S*, and we believe that these documented recommendations are actionable. This conclusion is based on the seriousness of each gap and its impact on FEMS operation, as well as the estimated cost and timeframe to remedy the current issues using *FASTER C/S.*

1.2.2 Fleet Composition and Replacement

The FEMS Fleet is composed of 369 vehicles and other motorized and non-motorized equipment for which the AD is responsible. In addition FEMS leases 42 passenger vehicles from the U.S. Government's General Services Administration (GSA). These vehicles are maintained by GSA, not FEMS.

The apparatus inventory we conducted revealed a fleet that is aging, showing signs of excessive wear-and-tear, and in overall poor condition that is reflective of years of hard, urban emergency driving compounded by unstructured and deferred preventative maintenance and repairs. As one might expect, newer apparatus were found to be generally in better shape than older apparatus, but even newer apparatus often had maintenance issues.

Given how hard FEMS works its apparatus (a function of call volume, road conditions, and driving behaviors), it can be concluded that the apparatus will fail unless it is adequately maintained for the entirety of its service life. In addition to being well maintained, apparatus must be replaced when it has reached the end of its serviceable life. Failing to replace apparatus as needed causes the frequency, cost, and difficulty of maintenance and repair to soar and proves to be an impediment to servicing other, more functional apparatus.

Based on the previous experience of the Project Team in assessing and auditing other fire and EMS agencies' fleets of similar size and composition, our analysis of the FEMS fleet demonstrates that a sizable portion of both the frontline and reserve units are in subpar condition

in relation to these comparable departments. At FEMS, units frequently undergo repeated repairs for the same or similar problems. As a group, reserve truck companies are in especially poor condition. EMS transport vehicles comprise the largest class of vehicles in the fleet. Given that they are worked almost non-stop, it is little surprise that the older EMS units (the current Ford ambulances) are in bad shape, both in terms of physical and engine condition. These units fail regularly and, as a class, account for the largest portion of work performed by the Shop. In fact, the current Ford ambulances account for almost the same amount of mechanics' effort as do all engines, trucks, and squads *combined.*

It is recommended that FEMS implements a reserve fleet that is capable of providing high-quality backup apparatus to replace frontline apparatus taken out of service for either maintenance or repairs. In order to ensure that a full complement of apparatus is available to support the Department's current deployment plan, we recommend an aggressive apparatus replacement plan that acknowledges the high call volume and heavy demands placed on the apparatus and the unique responsibilities and demands that are an outgrowth of the role FEMS plays in protecting the Nation's capital. This plan calls for engines, trucks, and squads that are have no more than 7 years in frontline service, another 3-4 years in "ready reserve" service, and a final 3-4 years in reserve service, for an average total service life of between 13 and 15 years. Ambulances would serve a total of 3 years in frontline service, another 2 years as either a "ready reserve" or special events unit, and another 2 years in reserve service, for an average total service life of 7 years. Passenger vehicles and SUVs should be replaced approximately every 7 years, based on the actual condition and usage of the vehicle.

Apparatus replacement should follow a consistent schedule which spreads new acquisitions over time, rather than the current practice of acquiring vehicles in spurts, which produces peaks and valleys in the collective aging of the fleet. Ensuring a consistent, but smaller, number of apparatus is procured each year will result in the vehicle replacement budget and the overall maintenance and repair effort being evened out. Going forward, apparatus replacement should not be deferred to achieve short-term budgetary savings, because such savings are accomplished at a long-term cost – having to catch up in later years or face winding up with a fleet in equally bad shape.

1.2.3 Apparatus Division Operations

The FEMS fleet is currently in a critical state, with chronic long-term management, maintenance, and replacement issues. FEMS apparatus routinely break down, forcing the AD to spend a disproportionate amount of time working on critical repairs rather than preventative maintenance. Because these issues have been endemic over many years, keeping the FEMS fleet running is a momentous task. To break this cycle would require a major strategic intervention and investments in infrastructure, codifying effective policies and procedures, and allocating personnel and technical resources appropriately to effectuate change.

While addressing the problems in the AD falls to the current administration, they are not of its creation – the problems are systemic in nature and the result of budget cutting and organizational neglect that has occurred over a span of 15 to 20 years (at a minimum). There is no one single overriding problem in the AD. Rather, severe problems exist in all facets of the AD:

- Management Information Systems (discussed in Section 3)
- People
- Processes
- Physical Infrastructure
- Policies and Procedures
- Procurement

Exacerbating the problems at the AD is the excessive wear-and-tear on the FEMS fleet caused by the extraordinarily high call volume – especially of EMS calls.

1.2.3.1 *People Issues*

The Shop is staffed with both uniformed and civilian personnel, the latter of whom actually perform the work on the vehicles. Many firefighters of all ranks have a general negative view of Shop personnel because of the recurrent problems with unrepaired apparatus, continuous breakdowns, repair downtimes, and reported things that need fixing and are either put off again and an again, or never addressed at all.

We believe that the AD is ill-served by being headed by uniformed personnel. Fleet management is its own profession. Today's fleet managers need to know about customer service, information technology, accounting, purchasing, vehicle storage, preventative maintenance and repair of different classes of vehicles, and inventory management and reporting. Managing a modern fleet is more akin to running a large business than it is to responding to medical emergencies or putting out fires. Furthermore, having a uniformed firefighter head the AD has led to instability in its leadership because uniformed personnel are subject to frequent reassignment.

In addition to having a civilian fleet professional heading the AD, we believe that the AD would be best served by the creation of new positions, including a quality control specialist on each shift, an IT/data analyst, a parts specialist, and a Shop manager. Many of these could be contractual positions, but could also be District employees if FEMS decided against outsourcing.

Using a widely accepted methodology called Maintenance and Repair Unit Analysis, we calculated the number of mechanics needed to adequately service the workload of the Shop. When one looks solely at the numbers, we believe that FEMS presently has a sufficient number of mechanics for the imputed workload; however, the algorithmic approach to calculating the

number of mechanics needed assumes that a shop operates efficiently and that its mechanics would be considered productive according to most industry standards. Findings from this audit show that this is clearly not the case for the FEMS Shop**.** Accordingly, we believe that in the short run, the number of mechanics needed is artificially higher than it would be were these issues not present. Once problems with the fleet inventory and Shop productivity are addressed, the number of mechanics needed will be lower, but this could take a year or more to correct.

In other words, to answer the question of how many mechanics are needed, one must view the solution as occurring in two phases. In the first phase (immediate to short-term), as many as four more mechanics than the current total of 15 mechanics would be needed to deal with the high demand for service and low efficiency of the Shop (See Section 5.2.2.1). In the second phase (after implementing process improvements), 14 mechanics should be sufficient for a fleet of the present size and distribution, by type of apparatus.

As discussed in Section 5.2.1.2, there is an unacceptable lack of activity in the Shop. This is a function of poor oversight of floor activities by the Shop foremen but also a lack of any system of performance management. There are no clearly stated expectations for how long various repairs and maintenance should take (in commercial automotive repair settings, these expectations are set forth in the form of book time). Additionally, because mechanic timekeeping in FASTER is haphazard, the AD lacks the ability to review individual mechanics' productivity against a set of objective, quantifiable criteria governing how long each type of repair should take. This means that there is no basis to hold the mechanic accountable for the time he is taking on the work he is doing.

Additionally, since there is no quality control inspection of mechanics work, there is no way to determine whether a given mechanic's work is of satisfactory quality. Highly performing shops regularly assess the come-back rates (i.e., how often a vehicle comes back to the shop for the same repair within a certain time period) for each mechanic. FEMS does not examine this or any other metric for its mechanics. Because there is no objective measure of mechanics' performance within current business processes, mechanics are not routinely held accountable for their throughput or the quality of their work. Because the foremen do not appear to be regularly engaged in overseeing the work on the floor, mechanics have no incentive to stay on top of their work.

The Project Team is not aware of any other fleet shop (emergency services or not) that works three shifts. In terms of best practices that we have researched and observed, we believe that elimination of the night shift should be considered, as should elimination of weekend hours. We believe these changes would offer real advantages discussed in Section 5.2.4.1.

We believe that higher quality operations and results could be obtained by outsourcing the operations of the Shop. Outsourcing in this manner affords FEMS a rapid way to obtain a professional fleet industry management and operation of the Shop. Among other incentives

discussed in Section 5.2.5.3, the primary advantage of outsourcing the entire operation is that a private-sector vendor has a built-in financial incentive to hold foremen and mechanics accountable to meeting performance objectives.

At the *very least*, the AD should divest itself of all responsibility for servicing light- and medium-duty apparatus, as these repairs can almost always be done at a vendor's shop. Splitting off these two classes of vehicles will lessen the Shop's workload and allow FEMS mechanics to focus on the most mission-critical equipment.

Many mechanics had not received *any* technical training in several years. Most mechanics do not receive any other formal training other than that which they pursue on their own. Most Shop personnel were eager to be trained and were frustrated at the lack of availability or incentives in this respect. It is vital that Shop personnel be able to obtain and maintain the industry-standard certifications, such as Automotive Service Excellence and Emergency Vehicle Technician. Safety and morale issues abound at the Shop, and neither appears to have been taken seriously for a long time.

1.2.3.2 *Process Issues*

The most glaring problem that the Project Team identified is the virtual absence of a preventative maintenance (PM) program in the AD. Having a strong PM program is a best practice and is integral to the sound fleet operation of any fire department. PM is, at its core, a universally accepted industry standard which is embodied in both NFPA 1915 and private sector fleet operations. The high call volume that FEMS handles takes its toll in wear-and-tear on the apparatus. It is simply impossible to subject apparatus to the 24/7 beating that most FEMS vehicles endure, not maintain them, and then expect them not to break down. Deferred maintenance does not defer the problems – it simply makes them more expensive to fix when they do emerge. For the most part, apparatus issues are addressed only after a failure – not in a proactive manner. This practice is not in line with industry standards, and it fails to meet the "common sense" test.

Every well-managed, smoothly running shop is strict about its mechanics reporting their time assiduously. Mechanics need to clock in and clock out of vehicles as soon as possible because accurate timekeeping is *essential* to understanding the labor costs of maintaining a given vehicle. In current practice in the FEMS Shop, mechanics routinely stay logged into vehicles while they are working on other vehicles, taking breaks, etc. or do not log into vehicles at all (see Section 5.2.2.1). This renders the data in FASTER virtually useless for managing Shop operations or the overall fleet. For example, as was noted earlier, it is not possible for us to calculate the Total Cost of Ownership of any vehicle in the FEMS fleet because required data have not been captured in FASTER. The AD should issue and strictly enforce a policy on timekeeping. FASTER should be configured to capture time for a range of activities so that the AD leadership

can better manage personnel and make more informed decisions about vehicle maintenance and replacement.

The AD needs to develop Key Performance Indicators (KPIs) which address its need to manage its operations. These KPIs should form the core of daily, weekly, and monthly reports which show how the AD is meeting its performance objectives and how individuals within the AD are contributing to that overall mission. By sharing these metrics transparently, everyone within the AD will have a common incentive to keep their individual and collective performance at expected levels. AD and FEMS leadership should review relevant KPIs daily so they can stay on top of managing the fleet.

Even if the decision is made not to outsource all Shop operations, FEMS should strongly consider outsourcing the maintenance and repair of light-duty vehicles, towing, and the parts inventory function. Divesting any (or all) of these functions will allow the Shop to stick to its core competencies and central business functions. This functional rationalization is urgently needed if the AD is ever to clear its backlog of work and begin to maintain pace with the demand for services.

There are numerous other best practices that have been recommended for adoption at the Shop (see Appendix IV), including automated vehicle checkouts, station-based deficiency reporting, use of synthetic oils, etc. However, the most important best practices that FEMS could address are the implementation of a sacrosanct PM program coupled with strict timekeeping in FASTER. These latter two best practices represent priority essential recommendations that, if implemented as recommended, are likely to have the most advantageous outcomes and benefits for the FEMS, including facilitating the AD's success in gaining control of its operations.

FEMS loses countless in-service time to changing over in-service apparatus to reserve apparatus. To combat this loss of service time, FEMS should strive to ensure that "ready reserve" apparatus are as available as possible. It is essential that crews be able to rapidly put another piece of apparatus in service in place of frontline apparatus that needs to be taken offline. This ensures that there is no disincentive to bringing a piece of apparatus in for PM or repairs. Likewise, collocating the service and logistics functions will help minimize out-of-service time as well as having to shuttle apparatus back and forth between the Shop and Logistics.

FEMS has a rate of reworking repairs that is nearly 20 times the industry standard! A high-caliber quality control function is an important ingredient in preventing unnecessary rework and avoiding the frustration that crews feel when a piece of apparatus comes back from the Shop with reported problems unaddressed. *Every* repair and PM activity (including that which is performed by vendors) should receive a quality control check. This is both a safety and a cost concern. It is far better to catch inadequate work before the vehicle leaves a repair facility than afterwards. Moreover, in terms of mechanic accountability and performance, the quality of the work done is as important as its timeliness.

Reducing the existing backlog of work at the Shop will require both demand reduction as well as productivity improvement. Demand reduction takes the form of getting rid of the current Ford ambulances, replacing apparatus according to schedule, and implementing a strong PM program. Productivity improvement involves supervising mechanics more closely, temporarily adding more mechanics, eliminating night and weekend shifts, ensuring adequate parts supply, implementing quality control, data-driven management, and the shedding of non-core activities.

1.2.3.3 *Physical Infrastructure Issues*

Good physical infrastructure underpins the ability of any fleet maintenance organization to conduct any repairs in a safe and efficient manner. A well-organized shop with sufficient space both to make and oversee repairs is absolutely essential for the AD.

The Shop lacks good ventilation, and is dirty, dark, and extremely crowded. It is an uninviting and inhospitable place to work. The physical layout of the Shop and the parts storage area are inefficient and do not lend themselves to good management on the part of the foremen. The facility is also lacking lifts and pits found in most modern shops. There is inadequate interior storage space for vehicles awaiting service or pick-up, necessitating that vehicles be stored in the open and, frequently, on the street. Although the main repair floor is large in comparison to that in a number of the comparison jurisdictions, any size advantage is entirely offset by the Shop's poor layout. Given the changes in the size of the fleet and the size of individual apparatus that compose the fleet since the Shop was built, the facility has outlived its useful life.

1.2.3.4 *Policies and Procedures Issues*

Having a set of well-written, well-planned, systematic, and structured performance guidelines and policies in the form of a Standard Operating Procedure (SOP) document or handbook is one of the most important keys to success for a fleet management organization. Unfortunately, the AD does not have documented fleet management policies which specifically govern the non-uniformed foreman, mechanics, ticket writers, dedicated PM schedules or procedures, and Shop operations. Additionally, there is no written mechanism within the organizational structure, procedurally or otherwise, which systematically addresses work that is in the process of being done or work that is to be done.

It is imperative that the AD create and adopt a SOP document with a set of policies, procedures and guidelines which comprehensively cover every aspect of fleet management operations. The SOPs should include, but not be limited to, specific policies directed at foreman and mechanic productivity, the relative priority for repair of various vehicles, repair time expectations, and minimizing downtime of units. SOPs should also address standards and procedures with regard to enhanced and consistent improvement of customer service. Most importantly, the SOPs must establish strict schedules and rules for an unwavering, comprehensive, and consistent PM program for the entire fleet.

1.2.3.5 *Procurement Issues*

Some aspects of apparatus procurement unwittingly hamper the AD's ability to keep the fleet running. Changing the way apparatus are procured could improve the quality of the apparatus procured, increase FEMS' ability to adhere to a fleet replacement plan, and ensure that vendors give better support to the AD.

FEMS is generally required to award apparatus contracts to the lowest bidder. Low-bid contracting only encourages vendors to provide the minimum acceptable apparatus at the lowest price. This incentivizes vendors to cut corners and provide as little technical support as possible in an effort to keep costs low. We believe that FEMS would be better served by awarding contracts on a "best-value" basis – in other words, FEMS could award a contract to vendor which had submitted a higher bid which offers a better value to the District because of the quality/features of the apparatus and/or warranty/technical support promised.

We strongly believe that the District would benefit greatly by issuing apparatus contracts for extended periods – between 5 and 8 years. Longer contracts would be more attractive for vendors, thus incentivizing them to offer FEMS more in terms of price, warranty conditions, technical support and training for mechanics and field personnel, and willingness to accommodate FEMS' special requests and specifications.

Standardization of each class of apparatus across the fleet offers a number of benefits. One means to obtain standardization and lower costs is to order "commercial" (i.e., factory standard) apparatus. The alternative to commercial is "custom" (i.e., built to client specifications with few, if any, factory-standard options). In the case of FEMS, we believe that it is likely that commercial (as opposed to highly customized) apparatus that can fit in FEMS' smaller stations can be procured, and that it will suit the Department's needs and save it money. Given the high call volume, tough driving conditions, and potential for collisions, the benefits of keeping apparatus design, construction, and procurement as simple and inexpensive as possible argue for selecting commercial apparatus.

FEMS should ensure fuller participation of Shop mechanics on the Apparatus Committee and should regard on-site factory meetings (for engineering, post-paint, and final acceptance visits) as crucial to a successful procurement. FEMS should favor ambulance designs that facilitate maintenance (such as tilt cabs that permit mechanics easy access to crucial systems). FEMS should also consider procuring ambulances with more robust air conditioning systems (many of the ambulances we observed had non-functional air conditioning, leading to interior temperatures that were unacceptable for either patients or crews) and improved emergency lighting.

1.2.4 Station-based Operations

In-station activities have an impact on the condition of the apparatus, which ultimately has an impact on the operations of the AD. Vehicle checkouts are not automated, meaning information

captured during the checkout process is effectively unavailable to the AD. Automating the checkout using the ZONAR system would enable identified problems to be automatically captured in FASTER, ensuring greater visibility to management and, therefore, greater accountability. Additionally, using the ZONAR system would provide the AD the means to ensure that station personnel are performing daily inspections properly. In-station reporting of vehicle deficiencies directly within FASTER allow better scheduling of maintenance and repairs. Additionally, in-station deficiency reporting is an essential link to ensuring greater accountability of Shop personnel.

Finally, the Department should examine the possibility of allowing certain easily accomplished repairs (e.g., fluid top-offs and light bulb changes) to be accomplished by adequately trained station personnel. This would eliminate the necessity to place apparatus out of service for relatively low-acuity mechanical issues and would reduce demand on the Shop accordingly. Likewise, broken Vogel Lube systems should be repaired and adequately maintained on all apparatus so equipped. These systems essentially automatically perform a form of on-going PM. The proper functioning of Vogel Lube systems saves money and in-service time.

1.2.5 Impact of ISO Rating Change

The District was last rated by the Insurance Services Office (ISO) in 2010. FEMS' rating from the evaluation was determined to be Class 2, based on its total score of 84.66. In the evaluation, the District scored highest in the areas of water supply and handling alarms. The scores the District received in these areas are indicative of a Class 1 system.

The tabulation from the 2010 ISO evaluation is depicted in Table 36 (on page 167). The District scored best overall in Handling of Alarms and Water Supply. In these areas, the District received 9 of a possible 10 points for Alarm Handling and 38 of 40 points for Water Supply. The Fire Department category received 41 of 50 points, with company staffing and training scoring lowest, 12 of 15 points and 5 of a possible 9 points, respectively.

The District could lose 4.6 points and still retain its Class 2 rating. This is because Class 2 communities can have an overall score of 80.01 and be rated Class 2. A score of 80 or less is Class 3 under the PPC. So long as there are no changes to the Alarm Handling or Water Supply systems, any reduction of less than 4.5 points within the Fire Department category would not affect the Class 2 rating.

Determining the exact impact of any changes in the fire suppression capabilities is not possible without knowing the specifics of the proposed changes. In general, however, if minor changes are made such as eliminating one or two engines or ladder trucks, it is probable that little, if any, change would occur to the ISO rating.

SECTION 2. INTRODUCTION

This section provides information about why and how this audit was conducted.

2.1 Background

As part of an initiative to improve fleet management and fleet operations, the D.C. Fire and Emergency Medical Services Department (FEMS), has retained the BDA Global team to conduct an assessment of its fleet maintenance operation and to inventory its fleet. The objective of the review is to provide FEMS with an analysis and subsequent recommendations to improve internal business processes, fleet preparedness, practices and systems, and provide a detailed up to date inventory in order to become more effective in supporting FEMS operations. The study was limited to specific areas within the Apparatus Division (AD).

A number of concerns have formed the impetus for this engagement and permeate the core of this study. Even the most casual observer of the D.C. metropolitan area media is probably aware of recent incidents that have gained the attention of D.C. residents and the D.C. Council. FEMS is in the process of implementing proactive measures to further improve fleet management, including contracting outside consulting services to perform this independent review of the current status of the AD and provide recommendations for operational improvement. Herein lies the impetus for this engagement.

2.2 Project Goals

FEMS' mission is to preserve life and promote health and safety through excellent prehospital treatment and transportation, fire prevention, fire suppression and rescue activities, and homeland security awareness. Through this project, FEMS aims to gain a better understanding of the readiness of its fleet and its ability to respond to emergencies with trained and qualified personnel and a robust fleet that meets operational standards.

In retaining the BDA Global team, FEMS' primary goal in conducting this review is to identify opportunities for improvement within an essentially moribund system and identify additional proactive measures for further development of fleet operations, systems, and processes managed by FEMS. The engagement has also provided the Department with an inventory audit on the total assets being managed by FEMS, including engines, ladder trucks, heavy duty rescue apparatus, ambulances, and refurbished ambulances.

While there are many dedicated and hardworking individuals at the FEMS Shop, the purpose of this report is to focus on opportunities for improvement, as opposed to the positive aspects of FEMS' performance observed during our review. In this way, this engagement is not designed to provide "attaboys" for processes, practices, and procedures the Department already performs

well; rather, the goal is to identify necessary improvements and recommended actions irrespective of whether they are already in process or will require Department approval for successful implementation.

Readers are asked to bear this in mind as they review this audit. We have, however, recognized certain areas where FEMS is successful in fleet management, maintenance, and repair, and those areas in which the Department should continue performing according to best practices.

2.3 Project Scope

As defined by the Office of Contracting and Procurement on behalf of FEMS, the BDA Global team has been retained as an independent, third-party consultant to conduct assessment of FEMS' fleet inventory and fleet maintenance operation. The work completed has included a comprehensive analysis of fleet preparedness programs and emergency contingencies, including document review, inventory analysis, human resource assessment, and a physical fleet audit to provide a comprehensive evaluation of the fleet's state of readiness, as well as compliance with recommended practices.

Various concerns about the AD and the FEMS fleet were conveyed in the Statement of Work contained in the Request for Bids as well as during our initial discussions with the Department's leadership. These concerns included:

- The age of the fleet
- A lack of adherence to an apparatus replacement schedule
- The age, physical condition, and size of the Shop
- Limited resources and budget
- Poor IT/FASTER utilization and support
- The need for a more efficient, effective and business-oriented fleet management model and management team
- Need for a viable, comprehensive, and aggressive Preventative Maintenance program
- Improved supervision, efficiency, and accountability on the Shop floor
- A well-trained and certified workforce

This report includes a comprehensive assessment for each of the following topic areas addressed as part of this audit:

- Fleet inventory, including current location, assignment, and existing condition of apparatus
- Fleet maintenance and repair operations

- Vehicle records
- The FASTER (FMIS) application and its implementation, as well as a comparison of FASTER with other available fleet management software
- FEMS policies and procedures related to fleet operations
- The number of reserve apparatus needed to maintain operations, and a comparison of that number to the Department's plans for emergency mobilization
- Reserve apparatus processes
- Storage capacity for the FEMS fleet, comparing available space to required space
- Training and certification of fleet maintenance personnel and facilities
- The Department's apparatus specifications and specifications development processes to standardize the quality of specification with the industry standards
- Small tools repair and maintenance
- Per-unit costs for each class of apparatus and expected life cycle costs

The men and women of FEMS and the Chief of the Department are to be commended on their desire to address the serious problems facing the AD. Although they have undertaken incremental steps to address these problems, the issues will not be resolved overnight. The needed changes may take years – not weeks or months – to produce the desired results.

2.4 Methodology

This audit was a complex undertaking. The methodology employed was based on successful approaches developed by BDA Global, TriData, and Mercury Associates over the past 30 years. Effective studies require input from all major stakeholders. Consequently, extensive interviews were conducted with key management officials, Shop personnel, frontline FEMS personnel, labor representatives, and other D.C. Government fleet managers. Additionally, a considerable amount of information was gathered through fire station visits, conference calls, e-mail exchanges, and additional research.

The study began in July 2013 with a Kick-off Conference involving the BDA Global/TriData/ Mercury study team in the DC Office of Contracts and Procurement (OCP) with OCP and FEMS officials, including the Chief of the Department. During the Kick-off Conference participants reviewed the scope of work and goals of the study, and discussed the specific data and information needed for the analysis.

The Project Team members conducted initial site visits to the FEMS Shop in July 2013, where the team met with representatives from the Shop, became familiar with the shop layout, and began interviews with shop personnel. During subsequent site visits, meetings were conducted

with the Fire Chief, FEMS administrative staff and other city agencies, including the D.C. Department of Public Works (DPW) and the D.C. Metropolitan Police Department (MPD). Starting in July and stretching into August, the Project Team then conducted a rigorous, time-intensive inventory of the entire FEMS fleet. This included daily briefings with the Shop administrative staff to reconcile data between our findings and current data held by FEMS.

It is important to understand that the inventory was an exercise to verify FEMS' vehicle records against the physical apparatus located by the Project Team. The data we generated on the condition of the apparatus did not represent an effort to grade each piece of apparatus according to objective and replicable criteria (Project Team members had neither the time nor the mechanic's training on heavy duty apparatus to be able to undertake such an effort); rather, these data were intended to be a rough, subjective estimate of the condition of each piece of apparatus based on Team members' experience operating and working from similar apparatus in other fire and EMS departments.

The audit of apparatus also required that the team visit every fire station and division (e.g., training and fire prevention) to track down and inventory all units. Ambulances were particularly difficult to find in quarters, and required team members to spend a significant amount of time at hospitals throughout the District in order to inventory those ambulances we did not find in quarters. Team members took the opportunity to interview and hold informal discussions with on-duty firefighters and EMS personnel during our visits to fire stations. Once onsite visits and the inventory were completed, the Project Team met with FEMS officials to review the initial findings of the triage.

Over the subsequent two months, the Project Team made follow-up site visits to gather additional information and conduct additional interviews. Data and background information, budgetary information, and personnel staffing records were also collected and reviewed, and contact was made with other jurisdictions to obtain comparative information. Throughout the project, team members continued to review information collected from interviews and analyze data. The Project Team met regularly to compare information, share ideas, and solicit input on major findings and recommendations. While individual Project Team members were assigned specific responsibilities, the end product is a collaborative and seamless effort.

2.5 Assumptions

The most important assumption for a report of this nature is that the organization possesses accurate data about its fleet and the dollar costs and labor time needed to maintain it. Without baseline data on fleet resources, it is extremely difficult to effectively analyze the fleet and to make recommendations with full confidence. Where there are gaps in available data, however, the Project Team has used trends gleaned from existing data coupled with empirical data compiled by the Project Team to support findings and recommendations.

It is important to point out that this study's scope of work did not include an analysis of FEMS' deployment of its resources. Such an analysis would require a separate complex study of its own. We took the current deployment as the baseline for our analysis and discussion of fleet management. Even if deployment changes, the analysis here should provide good guidance how fleet management can be handled.

The study also assumes that the overall call volume would not change *significantly* – in terms of the rate of growth, the nature of the incidents (i.e., EMS versus fire), or the geographic distribution of the calls. Analysis and projections of call volumes is a complex and lengthy undertaking that is beyond the scope of the present endeavor. We also assumed that the road surface and traffic conditions with which the FEMS vehicles and operators must contend on a daily basis would not change significantly.

The study also assumed that the Department would quickly take delivery of the following recently ordered apparatus: 30 ambulances (six of which were refurbished apparatus that FEMS presently owns), six engines, two trucks, and a fire boat.

Finally, some recommendations assume that the Department will undertake programmatic and operational changes intended to reduce the backlog of vehicles needing preventative maintenance (PM) and repair as well as the future overall demand for repair services.

2.6 Project Team

BDA Global, a Washington, DC-based full-service consultancy, was selected to conduct this study. BDA Global specializes in homeland security consulting and the provision of emergency management and contingency planning advisory services including strategic planning, logistical support, special projects management, organization assessments, performance measurement, business process mapping, review, and re-engineering, Lean Six-Sigma consulting, supply chain management, asset management, and continuity of operations planning for the first responder community. BDA Global has been in business for 10 years and their core team of consultants includes MBAs, CPAs, PhDs, Systems Developers, Lean Six-Sigma Certified Professionals, and Certified Business Continuity Professionals with more than 100 years of combined experience in supporting, evaluating, and improving business operations.

TriData, a division of System Planning Corporation located in Arlington, VA, was chosen by BDA Global to partner with them in this study. TriData has conducted technical research on fire and EMS related issues for over 30 years and has undertaken over 200 studies of this type, including a previous study for Washington, DC. Similar studies incorporating fleet management analyses have also been completed for major cities in the U.S. and Canada including Seattle, Chicago, Houston, Fort Worth, Saint Paul, Vancouver, and Portland, among others.

Mercury Associates, Inc. is an independent consulting firm headquartered in the Washington, DC area. Dedicated to providing objective, unbiased advice and technical guidance to organizations that operate fleets, its mission is to improve the quality of fleet management practices; the quality of goods and services utilized in the management and operation of fleets; and the quality of information technology and professional development services available to the fleet industry. Mercury Associates is a U.S. Small Business Administration and Department of Defense certified small business. Mercury Associates performed the FMIS assessment and FMIS evaluations for this project.

2.7 Report Organization

Following are brief descriptions of the major sections of this report.

SECTION 3 (Fleet Data Systems) – discusses the AD's use of the FASTER system and provides a comparative analysis of other fleet management information systems.

Section 4 (Fleet Composition) – discusses the composition and condition of the current fleet, reserve fleet requirements, and apparatus replacement.

Section 5 (Apparatus Division Operations) – provides an in-depth analysis of the operations of the Apparatus Division and makes recommendations for improvement.

Section 6 (Station-Based Operations) – discusses in-station operations and their impact on Apparatus Division operations.

Section 7 (Impact of ISO Rating Change) – discusses the potential impact of changing the District's Insurance Services Office rating.

2.8 Acknowledgements

We wish to thank the leadership, staff, and members of the D.C. Fire and Emergency Medical Services Department and the other District departments and agencies that provided their assistance for this project. They not only provided information and welcomed our visits, but also interacted thoughtfully and helpfully with the Project Team throughout the study.

Fire Chief Kenneth Ellerbe and many others, including firefighters, officers, civilian administrators, and other District staff members were extremely cooperative, gracious, and forthcoming during the project. They provided data, and facilitated and assisted with our detailed inventory of the FEMS fleet, and openly and candidly discussed the opportunities and challenges facing the organization.

We would particularly like to acknowledge the efforts of Battalion Chief John Donnelly and Deputy Chief Craig Baker, who acted as the FEMS project managers for the audit. We would also like to acknowledge the dedicated staff at the FEMS Shop for their cooperation and openness throughout the entire process of the study.

The Project Team would also like to thank the following individuals for their assistance:

Larry Jackson	Assistant Chief
David Miramontes, MD	Assistant Chief/Medical Director
Alysia Taylor	Chief of Staff
Paul Schaffer	Battalion Chief
Angelo Westfield	Captain
Spencer Ham	Captain
Tony Falwell	Captain
Larry Settle	Captain
Aaron C. Hazel, Sr.	Sergeant
Dan Leake	General Foreman
Dennis Rich	Mechanic Foreman
Gregory D. Jackson	Mechanic Foreman
Ralph Peterson	Mechanic Foreman
Jesse Ricks, Jr.	Mechanic Foreman
Torez Mitchell	Parts Specialist
Ed Leonard	IT Manager
Greg Hester	Fleet Director, MPD Fleet Management Branch
Ray Wade	General Manager, First Vehicle Services/MPD Fleet
Michael A. Carter	Fleet Administrator, DPW Fleet Management Administration
Rodney Philyaw	Computer Specialist, DPW Fleet Management Administration
Diane Rose	Computer Specialist, DPW Fleet Management Administration
Dabney Hudson	Local 36, IAFF
Kenneth Lyons	Local 3721, AFGE
Emory Crawford	Local 3721, AFGE

Additionally, we received invaluable cooperation from the cities of Baltimore, Boston, Philadelphia, Oakland, and Seattle and from Montgomery County, MD in the collection of information about their fire/EMS fleets, and for this assistance we thank those jurisdictions.

Although we received valuable input from various sources, the findings and recommendations contained in this report are those of the BDA Global/TriData/Mercury Project Team.

SECTION 3. FLEET DATA SYSTEMS

This section discusses Apparatus Division's use of the FASTER system and provides a comparative analysis of other fleet management information systems.

3.1 Assessment of FEMS' Use of FASTER

The primary benefit of a fully integrated fleet management information system (FMIS) is the ability to manage all aspects of fleet operation through a single interface or toolkit. Having all pertinent transactional and management data consolidated in a single system and available to all fleet users provides an effective tool for day-to-day management of the operation, a basis for timely management decisions and an efficient information retrieval and reporting platform.

Accurate, easily accessible information is crucial to all aspects of fleet management. Top tier FMIS systems are specifically tailored to meet fleet management needs and can accommodate:

- detailed vehicle inventory information
- multiple methods for tracking vehicle use
- tracking and managing equipment maintenance, repairs, recalls, and warranty activities performed commercially and internally
- work scheduling
- maintaining reportable, historical information on all equipment utilization, fueling, and maintenance and repair activities and costs
- parts inventory and processing detail
- labor hours tracking and cost calculations
- billing and cost analysis tools
- site-specific data

The system must also be intuitive to enable a range of users to work effectively with the system while providing enough flexibility to manage and extract critical data for management analysis.

The ability for fleet management organizations to provide their customers with information stored in their information systems through read-only reports that are accessed through secure Internet and Intranet web pages allows fleet customers to manage their own vehicles and equipment by looking at reports that show utilization, fuel consumption, billing records, and inventory details. Such reports also improve customer relations by providing transparency and a feeling on the part of customers that the fleet organization is ready and willing to provide complete information on fleet operations.

3.1.1 Current Program Status

FEMS utilizes Faster Asset Solutions' FASTER C/S as its FMIS. The system is recognized in the fleet industry as a reasonably priced second-tier system and is capable of providing all of the necessary functionality to manage a professional fleet operation. FEMS currently uses version FASTER C/S V5.69.109.122 SP B2, which is several releases behind the current version of the application.[3]

The FASTER FMIS is hosted and managed by DPW. The application is built on client/server architecture and is distributed to end users via thin client using MS Terminal Services and Citrix. DPW has a full time FMIS administrator who is responsible for managing user accounts and security, system settings, maintaining table file and system codes and providing training and support to FASTER users and external customers. Additionally DPW manages all fuel transaction posting.

It was reported to the team that the level of support experienced by FEMS staff is not consistent, and FEMS personnel have the impression that FEMS is not a priority customer for DPW's FASTER support team. Examples of unresolved issues are:

- FEMS not able to contact FASTER support for assistance – must channel all application or process related questions through DPW.
- System version lagging behind current released version and only limited information provided on upgrade timeline.
- No information provided on proposed implementation of FASTER Web version or the possible impact on FEMS users and its operation.
- Failure to respond to requests by FEMS to implement the FASTER dashboard tool.
- Lack of timely assistance in installation and configuration of new FEMS workstations.
- Limited input to FEMS on FASTER features and functions such as FASTER Service Center, graphics module, Automated PM scheduling etc. that may improve FEMS business procedures and data management.
- User security settings are not understood or documented and appear not to be consistent across the user roles.
- FEMS IT department prevented from accessing the database directly in order to provide custom management reporting, or developing tools to calculate and distribute Key Performance Indicators (KPIs) and trend analysis.

There is no service-level agreement (SLA) or contract that outlines the support or access expectations for FEMS from DPW as it pertains to FASTER. The FMIS is shared among three

[3] Current version is FASTER Win V 6.2

departments – FEMS, DPW and MPD – all of which pay an equal annual amount for use of the application including hardware and software maintenance support. As indicated in Table 1, DPW is, by far, the biggest user of the system – both in terms of the number of vehicles and users. FEMS and MPD have roughly the same number of users, but MPD has far more vehicles in the system.

Table 1. FMIS Vehicle and User Accounts

	Active Vehicles	User Count
DPW	2,992	172
FEMS	410	101[4]
MPD	1,972	97

It was reported that the majority of the FEMS user accounts in FMIS are inactive and there should only be active accounts for the current maintenance staff. Support and access costs should be allocated based on asset count and/or user accounts requiring access to the application. Typically web based applications are priced based solely on assets managed, but in the case of FASTER C/S, the system requires a Citrix license for each user account, so realistically the access cost should be scaled based on user count.

There are workstations distributed throughout the FEMS service facility including administrative, service writer and shop supervisor's area, shop floor and the parts room. The distribution of workstations appears to offer adequate coverage for primary staff system interaction and reference and research. We, however, observed that the system is not being used to reference historical maintenance and repair activities. The system is also not being used to schedule work or manage work in progress.

Additionally, a mobile service truck has a real-time connection to the network to allow use of the FMIS. It was reported that the system is not being consistently used by the mobile mechanic, and although there is an inventory of stock parts maintained on the mobile unit, the parts are not issued through the mobile terminal.

Users and management appear to believe that FASTER is not capable of supporting the FEMS maintenance and repair operation. We, however, found that the issues causing the apparently erroneous data stemmed primarily from incomplete operational procedures and processes, lack of consistent data capture standards, a misunderstanding of how the individual data elements provided detail for the overall management scheme and what management reports and performance indicators should be in place to monitor the overall operational status. Currently, there are few reports or performance indicators being used to manage the operation. In short,

[4] We believe access for approximately 20 FEMS users is all that is needed. Paying for unneeded user access is a waste of money.

while more powerful software exists, the problem is less the capability of the software than the understanding of its use and the data fed into it.

There appears to be a general lack of staff familiarization with the benefits of using an automated, modern FMIS and specific items that should and could be managed and measured through proper data analysis. There appeared to be an overall distrust in the ability of the application as an effective tool and a wide belief that the data is so poor that the reporting and historical benefits are minimal.

Various segments of the organization do not understand how they fit into the overall operational data flow. The key to effective management reporting and data analysis is to capture relevant, accurate information at the appropriate levels of the organization and then to use that information throughout the organization to measure and outline identified goals and priorities.

Staff comments indicated that there was an overall lack of application training. We were, however, also told by Shop administration personnel that training sessions in the use of FASTER have been held for all levels of staff. We believe that a combination of poor fleet management understanding, poorly defined business procedures, and poor quality data means that FEMS does not leverage the full range of fleet management capabilities that FASTER has to offer.

There is no central point of contact for all system-related items at FEMS – modern FMIS applications can be complex systems and operations can benefit from a support staff which understands critical fleet performance indicators, data structure, and data storage locations. FEMS should establish a FASTER System Administrator position responsible for data analysis and extraction, the development of management reports and business intelligence to measure performance, and communications skills to present those findings. Furthermore, the FASTER System Administrator should also provide system users with information, assistance, and training, and serve as the liaison between the fleet users, the DPW support group, and the application support team from FASTER *Asset Solutions*. (See Section 5.2.1.4 for a description of this position in a proposed organizational structure.)

3.1.2 Summary of Findings

1. The support provided to FEMS by the DPW FASTER Support Team is inconsistent, and several unresolved issues remain.
2. The majority of FEMS user accounts in FASTER are inactive, leading to inflated support and access costs.
3. FASTER is underutilized across distributed workstations with respect to reporting or deriving performance indicators and work scheduling.
4. The use of the mobile FASTER system by the mobile mechanic is inconsistent, and parts are not issued through the mobile terminal.

5. Operational procedures and processes for effective use of FASTER system are incomplete, including a lack of consistent data capture standards and minimal use of management information.
6. Staff lacks sufficient training in the FASTER application to make them thoroughly competent in its use.
7. Staff does not "buy into" the effectiveness of FASTER and the benefits of its use (because they have not been properly trained and are unaware of many of its features/benefits).
8. There is no central position responsible for FASTER system support, fleet data analysis, and management reporting.

3.1.3 Recommendations

1. Establish system support requirements and options, and determine the best method by which FEMS can achieve proper network and FMIS support; secure an SLA for support, if applicable.
2. Perform system maintenance to identify active and obsolete user accounts, negotiating proper system charge levels based on active user accounts.
3. Identify best practice information management, management reporting and performance indicators.
4. Analyze the processes and procedures required to provide the data needed to generate the intended result.
5. Take steps to provide remedial data normalization for existing inconsistencies, institute policies, procedures and user training to implement any changes needed to safeguard proper data management procedures.
6. Provide fleet management and FMIS system training matching business processes to FMIS system.
7. Establish a fleet IT analyst position, or identify a FEMS IT resource capable of providing fleet analytics and reporting assistance.

3.2 Assessment of Vehicle Records in FASTER

3.2.1 Current Status of Vehicle Records

New vehicles are entered into the FMIS and maintained by the General Foreman. Typically, this is a function of an administrative or asset management position.

The initial level of attribute details being captured and available for vehicle identification and management appears to be compatible with industry best practices.

Initial analysis of the active unit inventory contained in *FASTER* indicates that there are a total of 404[5] vehicles, apparatus, trailers and miscellaneous equipment organized between the current fire inventory and the inventory of GSA-leased vehicles. The combined inventory was distributed across 38 distinct classes with nearly 89 percent of the units owned by FEMS and the remaining 11 percent procured through the GSA lease.

Table 2. Active Unit Distribution by Type

VEHICLE TYPE	COUNT	AVG. AGE
Ambulance	95	4.1
ATV/Cart	5	7.0
Boat, Fire	2	1.8
Bus, HD	1	1.8
Bus, MD	2	7.8
Command Ctr	1	10.4
Forklift	5	18.5
Pickup	23	6.7
Sedan	69	7.7
SUV	44	5.4
Tractor	2	9.7
Trailer	21	7.0
Truck, HD	6	13.1
Truck, HD ARFF	1	1.8
Truck, HD Ladder	28	9.6
Truck, HD Pumper	53	8.8
Truck, HD Rescue	9	9.4
Truck, HD Tanker	1	12.1
Truck, HD Tow	1	0.5
Truck, MD	3	13.4
Truck, MD Fire	4	7.4
Truck, MD Wrecker	2	8.2
Van, Cargo	11	10.5
Van, HD Cargo	2	3.6
Van, Pass	13	8.7
TOTAL	**404**	**7.1**[6]

The inventory is assigned to individual departments within FEMS as indicated in Table 3.

[5] 10 additional records are being used for miscellaneous non-vehicle items such as gas cans, overhead charges, etc.

[6] The age of the boats was not used in average fleet age.

Table 3. Active Unit Distribution by Department

DEPARTMENT	COUNT
Administration Division	27
Apparatus Division	23
Communication Division	7
Emergency Ambulance Bureau	111
Facilities Maintenance	11
Fire Fighting Division	153
Fire Prevention Division	32
Office of The Fire Chief	6
Risk Management Division	1
Special Operations	23
Training Academy	10
TOTAL	**404**

The vehicles and equipment are organized by an FMIS company designation[7] and vehicle status. FEMS tracks units in three separate company designations: Active Fire Company, Leased Vehicles, and Retired/Inactive Fire Units, as shown in Table 4.

Table 4. Vehicle Company Distribution

COMPANY	VEHICLE STATUS	COUNT
ACTIVE FIRE COMPANY	UNKNOWN	1
ACTIVE FIRE COMPANY	ACTIVE	359
LEASED VEHICLES	ACTIVE	44
RETIRED/INACTIVE FIRE	ACTIVE	149
RETIRED/INACTIVE FIRE	CLOSED	97
RETIRED/INACTIVE FIRE	DISPOSE/DELETE	3
RETIRED/INACTIVE FIRE	RETURNED TO AGENCY (RENTAL)	1
RETIRED/INACTIVE FIRE	UNK	4
RETIRED/INACTIVE FIRE	TRANSFERRED	4
RETIRED/INACTIVE FIRE	PENDING PROPERTY DISPOSAL	23

Vehicle statuses are not being effectively used to indicate the current snapshot of the FEMS inventory. The designation "Retired/Inactive Fire Company" is generally intended for archiving of retired or disposed assets; however, as can be seen in Table 4, the majority of records in that group are identified as active units, even though they have been moved into the retired company. Furthermore, we believe that there are units removed from active service and awaiting disposal which have not been identified in FASTER as being out of service or pending property disposal.

[7] This FMIS company designator is not related to Fire Companies or Stations, but is simply a database separator.

Vehicle locations and assignments are not updated or managed in FASTER, but were reported to be tracked in a separate spreadsheet. Likewise, units moving in and out of frontline and reserve service are not updated in FMIS. This prevents maintenance staff from properly identifying priorities and assessing readiness and downtime/availability.

3.2.1.1 *Reconciliation of Physical Inventory and FASTER Records*

Overall, the total count and composition listed in FASTER fairly closely reconciles with the physical inventory conducted by the Project Team, with the following exceptions:

- Forty-four leased vehicles are listed in FASTER; however, only three of the current GSA vehicle numbers identified in the physical inventory were found in FASTER (meaning 41 of the numbers from the inventory were not in FASTER). This corresponds, however, to 41 unit numbers found in FASTER that were *not* found during the physical inventory. In other words, the total counts for GSA-leased units are the same between the physical count and the FASTER inventory, but the specific units may have been replaced and not properly updated in FASTER.
- Twenty units were listed as active in the FASTER system, but were not located during the physical inventory, as shown in Table 5. The Project Team was unable to locate (UTL) seven of these units. The Project Team was unable to inventory four units – one that was designated for Property Disposal Action (PDA), one that was at the manufacturer for a long-term repair, and two that had been impounded for investigative purposes. The status of the nine remaining units is "Unknown," four of which are generators. The most likely explanation is that these units have been disposed of through a PDA but the associated records have never been updated in FASTER.

Table 5. Units in the Active FASTER Fleet not Identified in Physical Inventory

UNIT ID	YEAR	MAKE	MODEL	CLASS	VIN	STATUS
007	2005	FORD	CROWN VIC	SEDAN	2FAHP71W85X157350	UTL
011	2008	FORD	CROWN VIC	SEDAN	2FAHP71V48X161391	UTL
021	2001	FORD	CROWN VIC	SEDAN	2FAFP71W41X165447	Unknown
2061G	2013	HONDA	EB5000X	TRL/GENERATOR	XXX	Unknown
2108G	2013	HONDA	EB5000X	TRL/GENERATOR	XXX	Unknown
2120G	2013	HONDA	EM5000SX	TRL/GENERATOR	XXX	Unknown
2128G	2005	HONDA	EB5000X	TRL/GENERATOR	XXX	Unknown
238	2009	CHEVROLET	SURBURBAN	SUV	1GNGK46K09R142745	UTL
240	2009	CHEVROLET	TAHOE	SUV	1GNFK13059R164690	UTL
246	2005	CHEVROLET	SUBURBAN	SUV	1GNFK16Z95J241838	UTL
386	1995	SEAGRAVE	TT06DA	AERIAL LADDER	1F9F038T3TCST2009	Unknown
405	2006	CHEVROLET	IMPALA	SEDAN	2G1WS551269275931	UTL
505	2008	FORD	E-450SD	AMBULANCE	1FDXE45P88DB26166	Unknown
518	2008	FORD	E-450SD	AMBULANCE	1FDXE45P08DB38196	PDA

UNIT ID	YEAR	MAKE	MODEL	CLASS	VIN	STATUS
554	2012	INTERNATIONAL	AMBULANCE	AMBULANCE	1HTMYSKM9CH629710	@ Manufacturer
558	2012	INTERNATIONAL	AMBULANCE	AMBULANCE	1HTMYSKM2CH050798	Impounded
696	2006	FORD	E-456	AMBULANCE	1FDXE45PX6HA93063	Impounded
729	1999	FORD	CF4000L	UTILITY TRUCK	1FTSE34F5XHA57641	UTL
786	1999	FORD	EXPLORER	SUV	1FMZU34E3XUC02204	Unknown
789	1997	TRAILER	TRAILER	TRAILER	XXX	Unknown

- The 13 units listed in Table 6 were found during the physical inventory but did not appear in FASTER. Most units in the table are shown as "Active" status, meaning that they are in regular use, but are not frontline (i.e., regularly dispatched) units. One unit, a 2012 Freightliner truck, was located at the Warehouse, but the Project Team was unable to conduct a physical inventory of the unit because it was locked up and no one could locate the key. This unit had not yet been placed in service ("Pending" status).

Table 6. Units Identified in Physical Inventory but not Listed in FASTER

STATION #	UNIT ID	VIN	TYPE	YEAR	MAKE	STATUS
SOD	N/A	0FB5079424	Segway	2009	Segway	Active
SOD	N/A	0FB5079425	Segway	2009	Segway	Active
Fleet	N/A	1C3CDZAB8DN512169	Forklift	2012	Clark	Active
Fleet	N/A	16MPF122XCD063033	Foam Trailer	2012	MGS, Inc.	Active
TA	N/A	1M0Z465TECM121105	Riding Mower	2012	John Deere	Active
TA	N/A	1M0Z425JPBM107775	Riding Mower	2011	John Deere	Active
TA	Unknown	2FAFP71W2YX198763	Sedan	Unk	Ford	Inactive
24	Unknown	2FAFP71W21X202509	Sedan	Unk	Ford	Inactive
Logistics	714	G12700217225K0F	Forklift	1976	Clark	Active
Logistics	N/A	NPR34500059700	Forklift	2008	Clark	Active
Fire Boat	N/A	1B181902	Inflatable Boat	2005	DIB	Frontline
Fire Boat	N/A	1MDAHKN185A311545	Boat Trailer	2005	Unknown	Frontline
Warehouse	N/A	1FVHC5DV1DHFA8291	Utility Truck	2012	Freightliner	Pending

3.2.1.2 *Additional Vehicle Record and Asset Management Observations*

Acquisition data is currently being tracked for vehicles – date of acquisition, in service date and purchase cost is recorded. Capitalization and projected replacement, however, are not recorded. Disposal detail is not being consistently maintained in the system. There are limited historical salvage value details. Records indicate that there have been no vehicles identified as being taken out of service since August 15, 2011 and no disposal values recorded since then.

Essential manufacturer warranty details are not being entered into FASTER. Advanced warranty notification capabilities are not configured or being utilized. This function enables the system to interactively notify the service writer, crew leader or mechanic when a warranted system is about to be repaired. This is currently accomplished through visual recognition by staff. It was

reported that there is difficulty receiving warranty service on apparatus. Excessive turn-around time from manufacturer's representatives or difficulty resolving chassis versus body warranty coverage between vendors hampers FEMS ability to procure adequate warranty service and they will often repair the problem internally rather than wait for the warranty information to be resolved to return the vehicle to service. Reimbursement from the manufacturers for these items is inconsistent.

The FASTER graphics module is capable of storing vehicle images, diagrams, invoices, purchase documents, or other documents pertinent to asset records. FEMS is not using the graphics functionality. This is unfortunate, as vehicle condition, specialty equipment placement, or accident-related damage records could be related to the work order or vehicle record.

Vehicles are classified in FASTER with a basic, FEMS-created vehicle classification system, which provides additional vehicle description, type, and usage of each group of vehicles. Using a more detailed vehicle classification system would allow comparisons and analysis of like grouping, regardless of make, and model of vehicle.

3.2.2 Vehicle Class Codes

DPW and FEMS are contemplating converting to class codes from the National Association of Fleet Administrators (NAFA). The NAFA class code schema is outlined below.

3.2.2.1 *NAFA Class Code Schema Overview*

The NAFA Standard Vehicle and Equipment Classification Code is a four-position numeric coding system that potentially accommodates up to 9999 vehicle classes. The codes are consistently organized within broad segments of the class codes facilitating manipulation within databases. The code names are designed to be intuitive and self-descriptive. The code system is configured as follows:

Class Code (Position 1)

The **Class Code** is based on the gross vehicle weight of the vehicle or equipment and is divided into weight classes commonly used in the fleet industry. Codes 0 and 9 are reserved for vehicles and equipment not commonly classified by weight. The weight code is key to a standardized classification of like equipment and corresponds easily to vehicle-related legislation such as the Clean Air Act and Energy Policy Act. The coding scheme also cross-references readily to other common classification systems such as the American Truck Association and American Public Works Association equipment codes and the Federal Emergency Management Agency cost codes. The Class Codes are as follows:

Table 7. NAFA Class Categories

CLASS INDEX	CLASS DESCRIPTION
0XXX	Non Self Propelled
1XXX	<8500 GVW
2XXX	8501- 10,000 GVW
3XXX	10,001- 14,000 GVW
4XXX	14,001- 16,000 GVW
5XXX	16,001- 19,500 GVW
6XXX	19,501- 26,000 GVW
7XXX	26,001- 33,000 GVW
8XXX	>33,000 GVW
9XXX	Off Road and Construction

Group Code (Position 2)

The **Group Code** describes the general physical or operating category of the vehicle or equipment within the class code. Examples would be Attachments, Automobile, Van, or Straight Truck. Group Codes are as follows:

Table 8. NAFA Group Codes

Group Code	Non-Self-Propelled 0	On-Road Vehicles 1-8	Off-Road Equipment 9
0			
1	Attachments	Cycles	Wheeled
2	Skid Mounted	Light Vehicles	Tracked
3	Trailer Mounted	Automobiles	Material Handling
4	Vehicle Mounted	Vans	Public Works
5	Stationary	Pickups	Mine and Tunnel
6	Grounds	Sport Utility	Grounds
7	Trailers	Straight Trucks	Watercraft
8	Semi-trailers	Truck Tractors	Aircraft
9	Other	Other	Other

Service Code (Position 3)

The **Service Code** describes the general type of use or application of the vehicle or equipment. Examples would be Air Compressor, Public Utilities, Fire Apparatus, or Bus. As with the Group Codes, Service Codes are internally consistent within the classification system.

Type Code (Position 4)

The **Type Code** describes the specific functional body type or use of the vehicle or equipment. Examples would be Sedan, Van Ambulance, Flat Bed, or Platform Aerial.

User Codes (Position 5 and higher)

The **User Code** is a user-defined field that allows the fleet operator to create classification categories to customize the NAFA codes to the specific needs of each fleet. The basic four-

position NAFA code may be expanded indefinitely to accommodate as many additional fields as the fleet operator may desire. Possible examples could include ladder length, bucket size, pump output, water capacity, etc.

3.2.3 Current Vehicle Classification Status

The vehicle classifications currently in place at FEMS are a mix of the previous user-defined class codes and the new NAFA codes. Table 9 lists class assignments and distributions for the active vehicles and equipment.

Table 9. FASTER Vehicle Classifications

FASTER CLASS CODE	CLASS DESCRIPTION	COUNT
6791	10-28 PASSENGER BUSES	1
ADMINVEH	Admin Vehicles	9
AMBU	AMBU	95
1320	AUTOMOBILE: COMPACT HYBRID	2
1342	AUTOMOBILE: FULL SIZE	1
BOAT	BOAT	2
BUS	BUS	2
COMBUS	Command Bus	1
CCOE	FIRE UNIT 1 TON UTILITY VAN	8
7FLI	FIRE UNIT AERIAL LADDER	28
7FRH	FIRE UNIT HD RECUE TRUCK 40 000 LBS	9
7FZG	FIRE UNIT HEAVY DUTY TRUCK 25000 LBS	1
7FZB	FIRE UNIT LIGHT TRUCK 0-6000 LBS	4
7FGF	FIRE UNIT MD TRUCK 25 000 LBS	4
CBTE	FIRE UNIT MINI VAN CARGO	2
7PFF	FIRE UNIT PUMPER	53
7FAL	FIRE/EMS SEDAN FULL SIZE	9
FOUT	FOAM UNIT	1
1212	LIGHT VEHICLES: GOLF CART: FOUR WHEELED	5
0360	NON SELF PROPELLED: TRAILER MOUNTED: CONSTRUCTION	3
0310	NON SELF PROPELLED: TRAILER MOUNTED: GENERATOR	5
0300	NON SELF PROPELLED: TRAILER MOUNTED: MESSAGE\ARROW	10
9623	OFF ROAD CONSTRUCTION: TRACTOR UTILITY	2
3512	PICKUP W/PLOW (9K-11.5K)	1
1513	PICKUPS: 1/4 TON COMPACT PICKUP TRUCK	1
1523	PICKUPS: HALF TON CREW CAB	11
RESC	RESC	2
SEDN	SEDN	54
SERV	SERV	4
SERVEQ	Service Equipment / Trailers	1
1620	SPORT UTILITY VEHICLE (SUV)	4

FASTER CLASS CODE	CLASS DESCRIPTION	COUNT
SUV	SUV	29
TRK	TRK	22
TRL	TRL	4
VAN	VAN	3
2422	VAN: CARGO STEP VAN	2
2410	VAN: WINDOW: 15 PASSENGER	1
1410	VAN: WINDOW: 7-8 PASSENGER (1/2 TON)	5
8731	WRECKER 4X2 24 000 LBS +	2
WRECKM	Wreckers Marked	1
	TOTAL UNIT COUNT	**404**

3.2.4 Summary of Findings

9. The count and composition of the physical inventory records listed in FASTER essentially reconciles with the physical inventory conducted by the Project Team of all FEMS fleet assets. The differences are relatively minor.
10. Capitalization and projected replacement are not currently recorded for vehicle and asset management purposes, and disposal detail is not being consistently maintained.
11. Advanced warranty notification capabilities are not currently configured for use, which is hampering procurement of adequate warranty service on apparatus.
12. The FASTER graphics module is not being used. Asset records including descriptions of vehicle condition, accident related damage records, etc., are not supported by vehicles images and other graphics, and could be with the current software functionality.
13. The simplified in-house vehicle classification system used by FEMS limits the ability to do more detailed comparison and analysis.
14. Vehicle classification status in place at FEMS is not consistent and comprises a combination of the previous user-defined class codes and the new NAFA codes.

3.2.5 Recommendations

8. Reconcile the physical inventory with the assets listed in FASTER.
9. Utilize FMIS to track attributes, assignments and locations of all vehicles enabling all fleet users to monitor real-time details and statuses.
10. Review all codification and applicable asset descriptors, groupings and distribution to ensure optimal system configuration to support asset management, reporting and analysis.
11. Record manufacturers and extended vehicle and component warranties, and enable automated warranty tracking to interactively notify the service writer, crew leader, or mechanic when a warranted system is about to be repaired.

12. Use the FASTER graphics module to store pictures, diagrams, invoices, purchase documents, etc. for use in supporting vehicle asset records, vehicle condition, specialty equipment placement and/or accident related damage records.
13. Employ a more consistent and detailed vehicle classification system to allow comparison and analysis of like grouping regardless of make and model of vehicle.

3.3 Assessment of FEMS' Use of FASTER to Manage Workload

3.3.1 Work Order Management

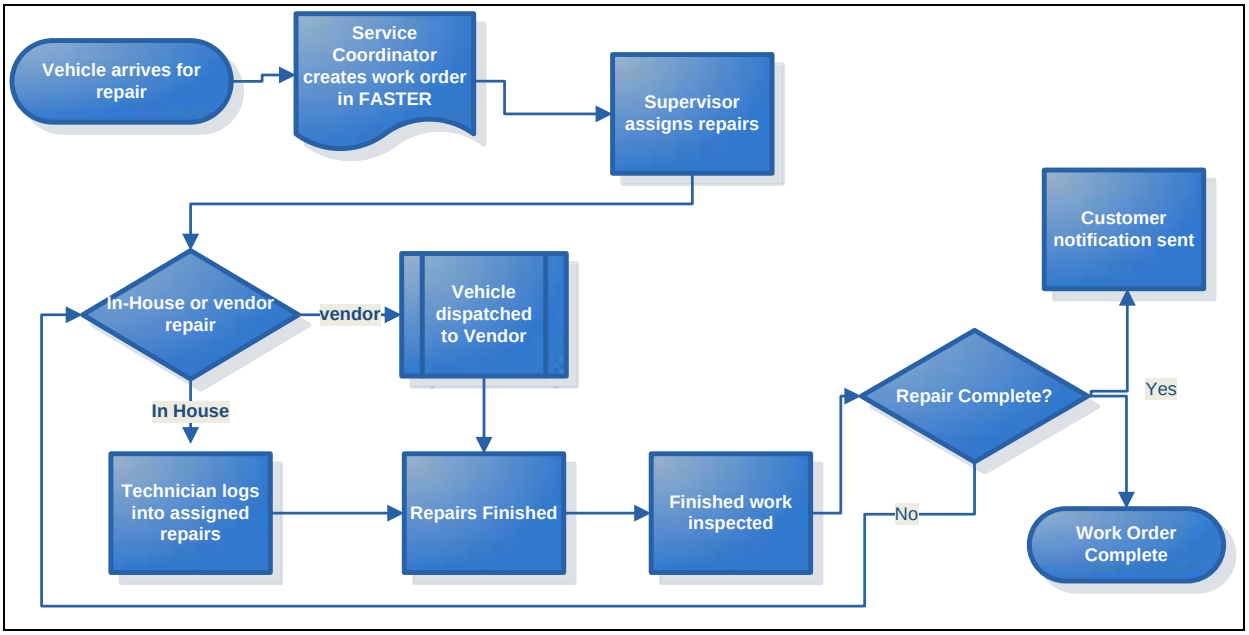
FEMS shop operations use broad business processes to manage the workflow in FASTER for in-house and commercial repairs and services. Existing procedures do not identify optimal separation of duties nor do they allow real-time online tracking of the work order life cycle. Work details and assignments have not been properly recorded in the system. This has prevented Shop management from being able to document and track the work currently in process or identify pending or current activities.

We found many of the issues related to work order management are highly interconnected, resulting in a cascading effect that reflects several inherent weaknesses:

- limited use of the FASTER system
- institutionalized and antiquated business practices
- poor quality management information

FEMS has several business processes that are outdated or ineffective and need to be evaluated and re-developed to leverage industry best practices and maximize the use of fleet management information technology. A well-designed and implemented system that includes industry standards for operational functions will help organizations attain and maintain best practice workflows and management functions. An example of a best practice workflow enforced by proper setup and use of an FMIS can be seen in the following diagram and outline of a labor transaction within a work order life cycle.

Figure 1. Work Order Business Process



1. The work order is created by the service coordinator when the vehicle arrives at the shop.
2. Required tasks are added, existing workload is analyzed, and new work is assigned to technicians or dispatched to a commercial vendor by the fleet services supervisor.
3. Work is performed by technicians logging real-time job activity or at commercial vendor.
4. Technician and/or senior technician inspects finished work.
5. The system notifies customers of completed work via e-mail once the shop activities are complete.
6. The work order document is reviewed for completeness, and the work order is closed.

Work statuses are managed at each level to indicate actual work order disposition and to pass the work order responsibility to the next level of activity (add repair, perform repair, inspect repair, finish work order, review parts issue, close work order etc.).

Each work process in the organization should be mapped to include the use of a fully capable FMIS to manage the individual work procedures.

Recently, a change in the vehicle intake process was initiated and a new service writer position established to facilitate the creation and management of work statuses. It appears that the new process is providing an improved and more consistent snapshot of work status.

Several procedures are adversely affecting the work order processes and the ability to measure downtime and productivity. Work orders can be opened prior to a vehicle arriving at the shop. These work orders are placed in an "in-service" status until the vehicle arrives for service. Some

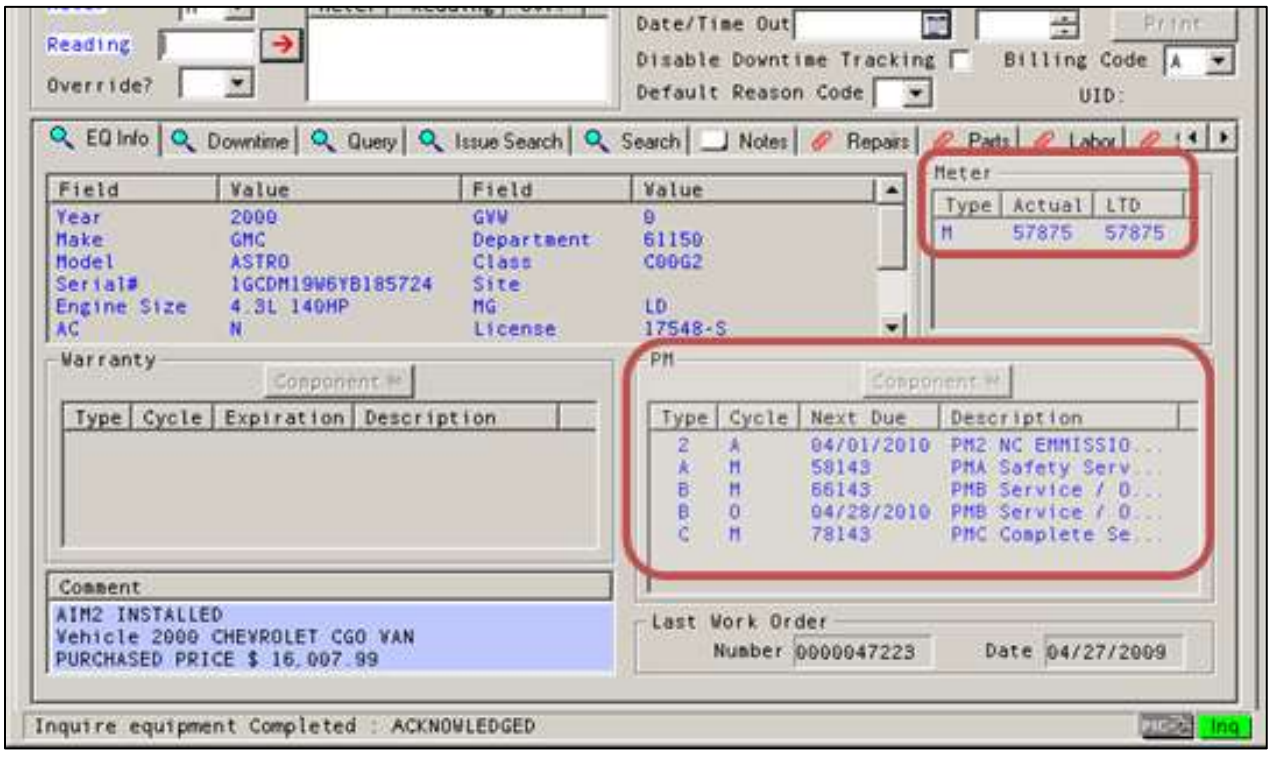
of these work orders are created to track deferred work or repairs that are awaiting a parts order; however, the system accommodates these deferred repairs and awaiting parts statuses without having work orders in a queue with no vehicle present.

When initiating a work order in FMIS, a unit number and an odometer/engine hour reading are the basic requirements to add the work order document. Currently, meter readings are not being required from operators when vehicles are brought for repair and updated readings are not being entered when opening the work order. The last recorded meter reading is typically accepted in order to add the work order and the current meter reading is not updated or verified while the unit is at the maintenance facility.

Additionally, FEMS is not recording meter readings on work orders when equipment is serviced, which causes inconsistencies in PM scheduling and utilization analysis.

For example, when an incorrect or lagging meter reading is entered on a work order that has a scheduled service performed, the next meter reading due for that vehicle will be based on that possibly erroneous meter reading. This is displayed in Figure 2 and Figure 3. On the work order applet, one can see that the actual meter reading on this piece of equipment is 57,875 miles with a PMA that will be due at 58,143 miles.

Figure 2. Work Order Applet Example



The meter reading on the work order in this example was incorrectly recorded at 56,000 miles when the vehicle was brought in and a PMA was added to the work order. The PM schedule on

the equipment record updated when the repair was completed. The results of the PM update can be seen in the graphical display of the equipment inventory applet. The last done and next due PM was improperly reset based on the incorrect meter reading of 56,000 miles. In this case, the next due PM is moved early in the cycle. The next PM due could, however, easily have been extended past the correct due cycle by incorrectly entering a meter reading that exceeded the current reading.

Technicians are currently logging some direct and indirect labor time using the FMIS technician's portal. When they log off of a task, the system prompts them to determine whether a repair has been completed, or whether the technician is planning on continuing to work on that task at a later time. If the technician indicates that they have completed the repair, it is marked in the work order as a completed repair and that task is no longer available to log labor against. It was observed that many tasks are not being properly completed in the system because the technicians are improperly indicating the repair's disposition when logging off. This can also cause incorrect or incomplete updating of next due scheduled repairs and PM services.

Figure 3. Incorrect PM Due Example on Equipment Record

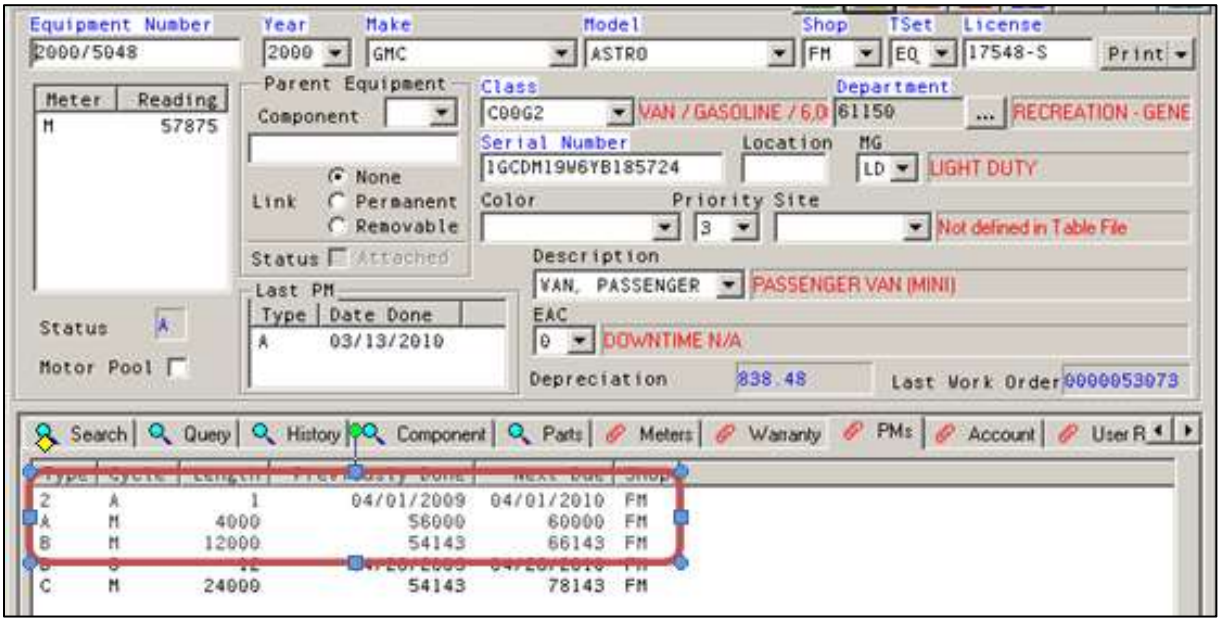
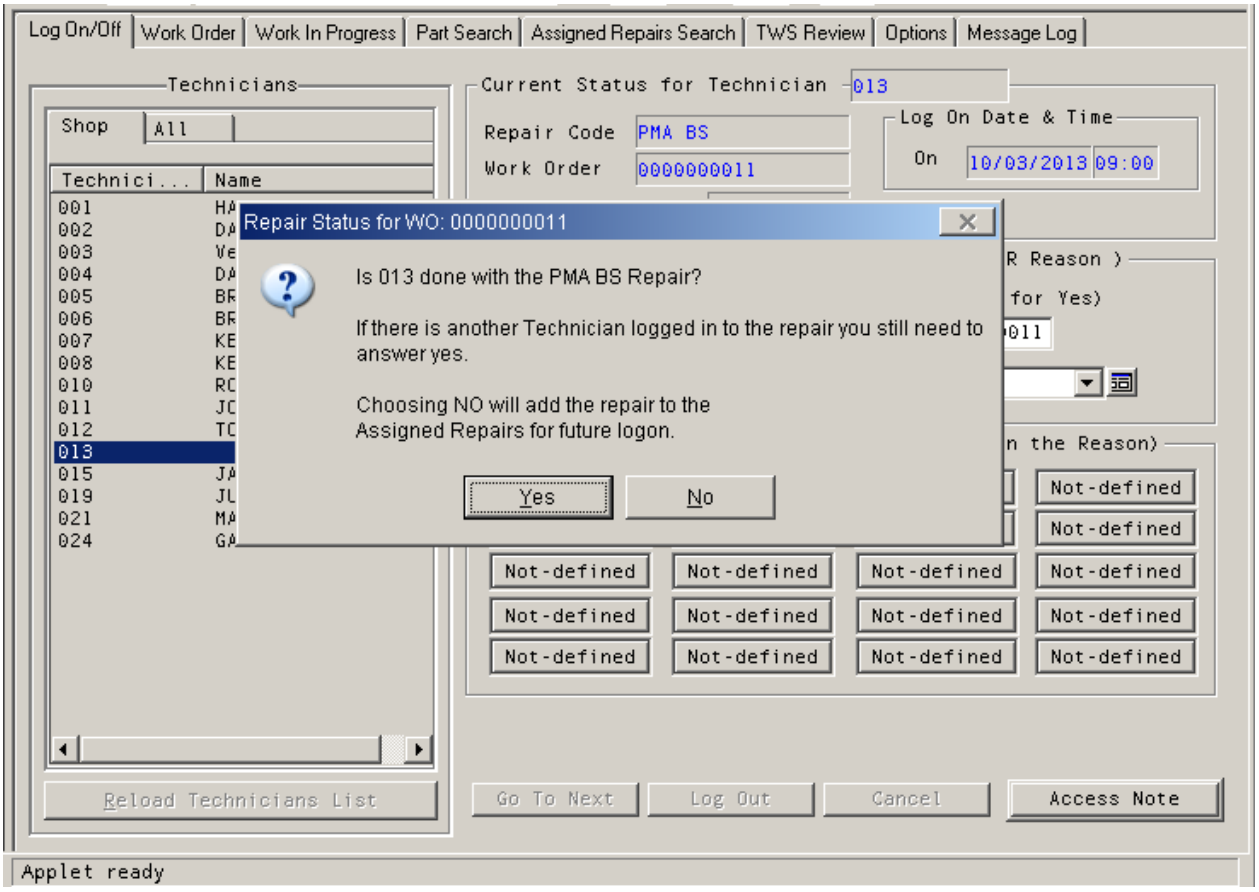


Figure 4. Technician's Labor Logging Procedure



Deferred repairs are tasks that are to be scheduled for a future time. This can be to accommodate a vehicle that is required back in service even though there is a minor repair required, or a vehicle that may need to have a part ordered to accomplish a repair, but is not a critical or safety related item. In either case, the system will notify the user when the vehicle arrives for repair that there is an outstanding or pending repair. Alternatively, the system can provide notice to the user to call the vehicle in for repair. At FEMS, the system is not properly notifying the users that deferred work is pending on a vehicle. This may be due to security settings on the workstation, or a setting preventing the notification from displaying.

Security settings for the service writers are preventing them from properly managing repairs while processing work orders to close. In the FMIS, if assigned repairs remain on the work order once the technicians have indicated they have finished all needed or assigned repairs, the work order cannot be placed in a closed status. Service writers should be presented with choices of how to process repairs that are still open when they are closing work orders that contain open repair transactions. Currently, the only choice that is presented is whether to defer repairs or not. If "defer" is the selection, the open repairs are deferred and the work order is closed. If "not defer" is the selection, the open repairs are deleted from the work order and the work order is closed. Furthermore, once the closing process is initiated, the user cannot cancel the operation

and the only options are to defer or not defer open repairs as outlined above. This is not acceptable management of open repairs. It is resulting in many repairs being simply deleted from work orders without the work being completed or a record of the remaining deferred repairs being available. We believe that this is a security setting within the application that should be reviewed to correct this issue.

Figure 5 –Figure 7 illustrate the proper sequence that should be automatically presented when closing work orders that have open (i.e., not yet completed) repair tasks still listed.

We observed widespread instances of data being recorded in free text or comments fields instead of utilizing proper data capture methodology using coded data elements to record the assigned repairs and resulting labor transactions on work orders. When data are recorded in this manner, it is extremely difficult to convert it into useful management information. Not consistently checking the quality and quantity of work performed by technicians and that the data being captured in the shop is accurate is a leading cause of poor data quality. Elaborate work order notes, and redundant listing of work done and parts issued in a free text comments field is not efficient or effective data management. A properly designed and implemented coding structure should ensure enough detail is available for follow up review and historical analysis without being overly burdensome on the users recording the detail.

Figure 5. Option to Defer Work

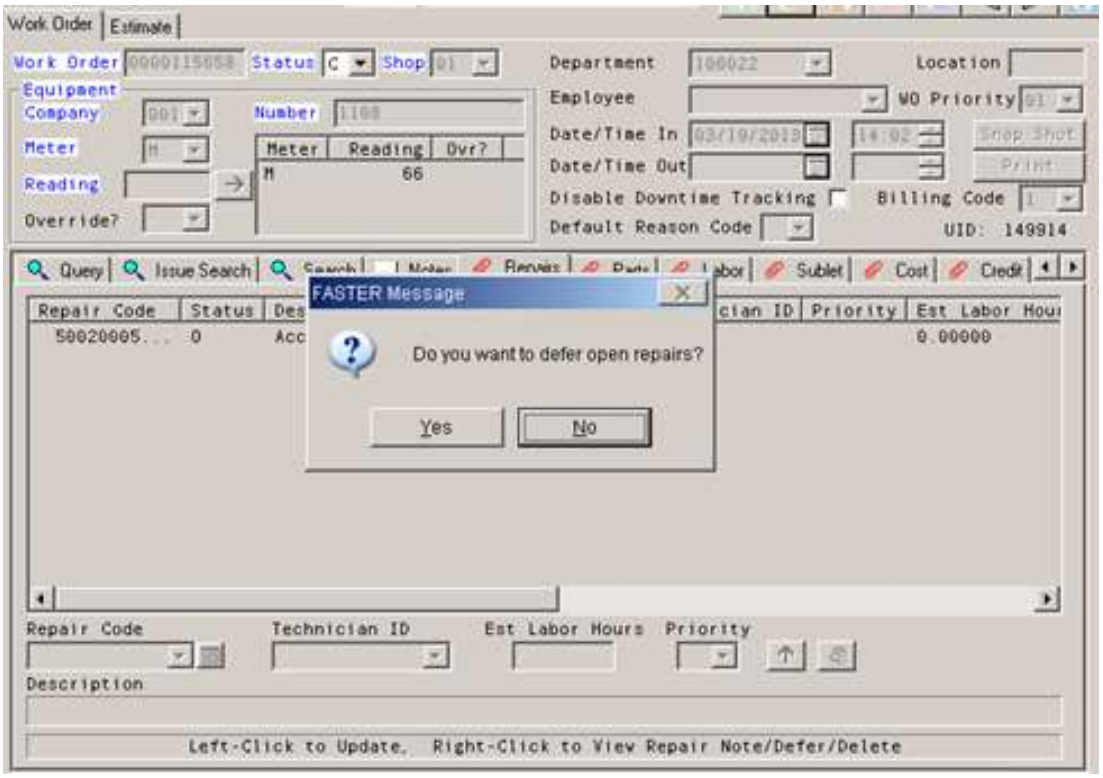


Figure 6. Option to Close Repairs

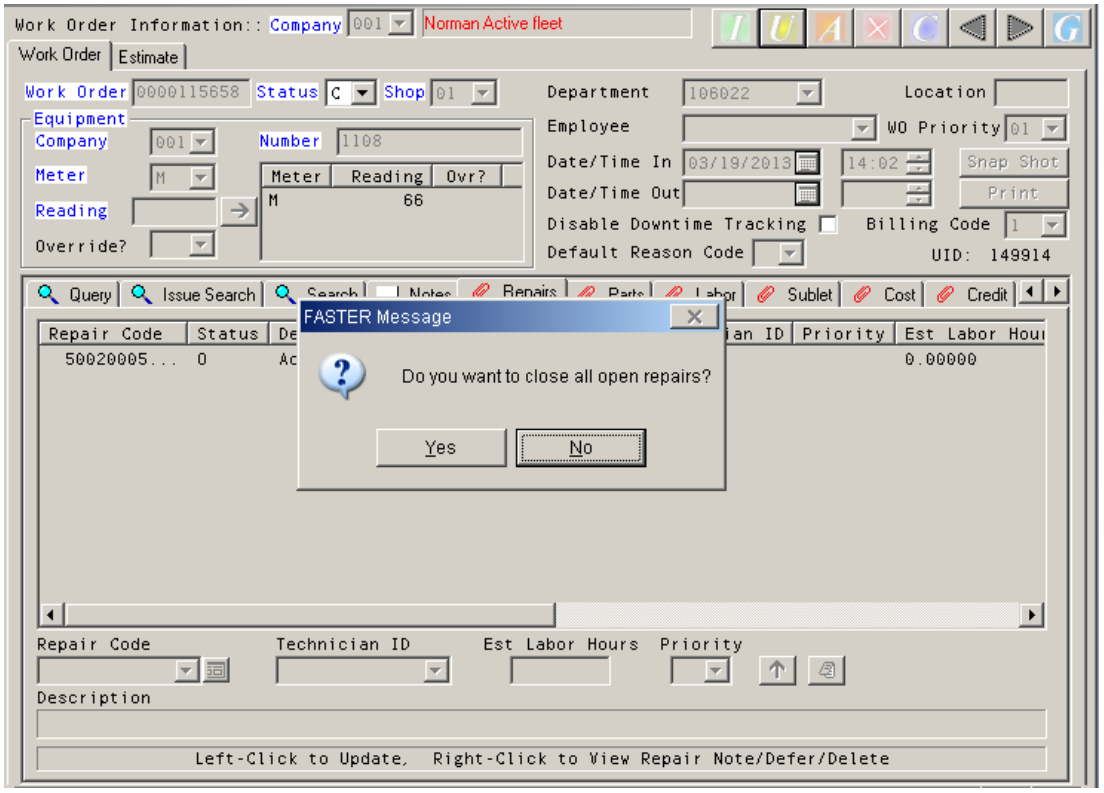
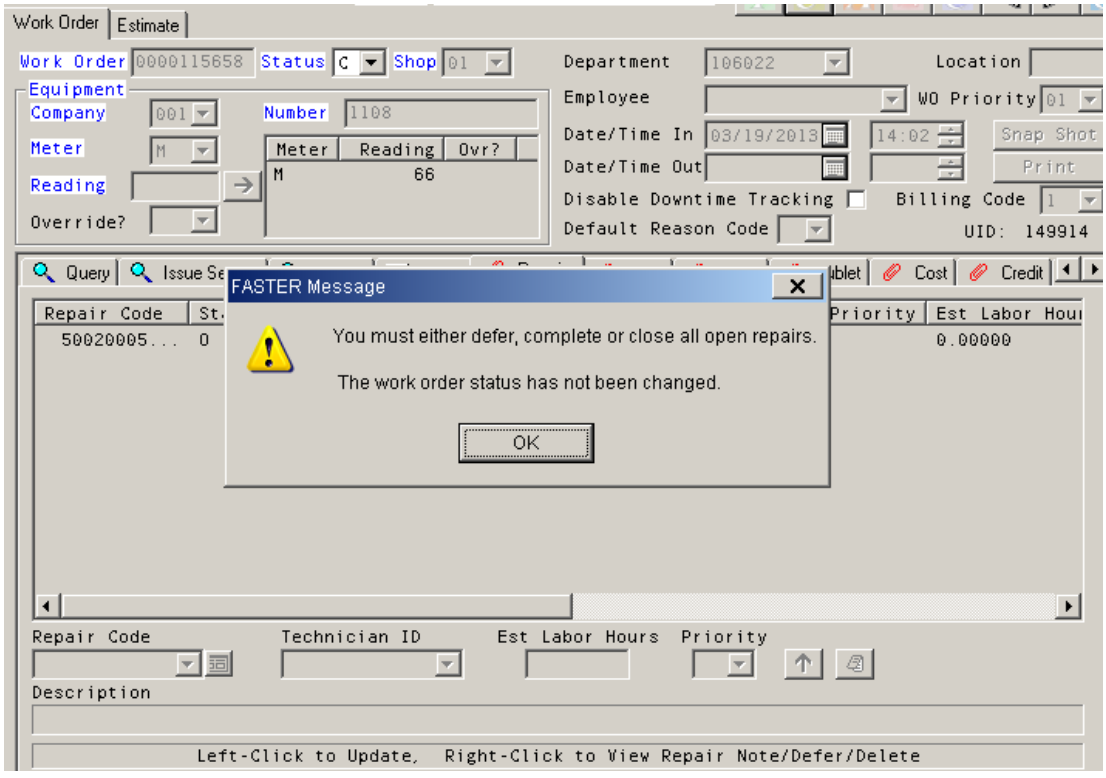


Figure 7. Disposition if Open Repairs Remain During Closing Process



There is an automatic repair being generated by a database trigger that is added to each work order for a preliminary walk-around inspection. This is a specific requirement for the MPD maintenance shop, and is not applicable to FEMS' current process. Currently this field is simply being ignored in most cases, but it is also being recorded as a deferred repair. This leads to an inflated count of deferred repairs and interferes with effectively closing completed work orders.

3.3.1.1 *Vehicle Downtime Calculations*

Vehicle downtime is a calculation of time, and reflects the amount of time a vehicle is not available for use by the assigned department because of vehicle condition or maintenance/repair operations. Downtime can be used to identify mission readiness.

In FASTER, the downtime calculation is dependent on an availability code assigned to each vehicle that identifies when a vehicle should be available to perform its primary function and work order statuses that detail the lifecycle of work orders. Work order statuses are identified by the organization as either being *downtime* (typically when a status can be controlled by the maintenance organization, such as awaiting mechanic assignment, awaiting parts, repairs in process (active), etc.) and *not downtime* (typically when the status is not under the maintenance operations control (awaiting department approval, awaiting insurance approval etc.).

For FASTER to track and calculate downtime accurately, specific processes and details must be adhered to:

- Work order statuses must be accurately identified as generating downtime or not generating downtime.
- Work orders must be created in FASTER as soon as vehicles arrive at the shop for repair.
- Work order statuses must be managed in real-time and accurately depict work order lifecycle.
- Equipment availability codes must be representative of the actual fleet readiness requirements.
- Equipment availability codes must be accurately assigned to assets representative of their actual readiness requirements.
- Availability codes must be monitored and managed to reflect changes in requirements or asset assignments.

Currently FEMS identifies 90 percent of its vehicles as "critical-need vehicles" (i.e., those required to be in service 24 hours per day/365 days per year). The schedule gives the impression that all vehicles are critical-need emergency response units, including the administrative vehicles and reserve units. Although these assets are important to the overall mission, we would not typically consider them as essential to frontline delivery of services to the public. Listing nearly

every vehicle in the fleet as a "critical-need vehicle" negates the AD's ability to prioritize its workload and schedule services based on the mission criticality of the asset.

Our analysis of the equipment downtime recorded by FEMS within FASTER based on the current availability and work status details[8] for the past 6 months are outlined in Table 10.

Table 10. Downtime Statistics

Total Number of Available Hours Required	1,708,200
Total Number of Hours Considered Downtime	243,562
Percent Downtime	14%

We believe that the downtime being used for the annual management report and performance plan is understated because the availability assignments and the work order lifecycle processes are not being accurately identified, managed, or recorded. Furthermore, downtime is not always an accurate measure of availability. For example, while a vehicle is held in the Shop awaiting an approval or another non-downtime status, downtime is not accrued within FASTER (as currently configured), but in actuality, the vehicle is also not available for the Department to perform its primary function.

FEMS generally reports fleet availability instead of downtime. The methodology of assuming that the inverse of downtime is availability is, however, flawed because of the conditions discussed earlier in this section that can affect downtime calculations.

Vehicle availability can also be measured between the work order open and closed date/time. This measurement is not affected by work order status changes or vehicle availability coding and could be considered the true time that a vehicle is not available for use by the department. Examples of these measures are shown in the following table.

Table 11. Availability (WO open – closed) by Select Class

Vehicle Class	Count	% Available
Ambulance	95	70%
Fire Unit Pumper	53	63%
Fire Unit Aerial	27	72%

The standard downtime calculations *can* provide an accurate availability measurement. FEMS should, however, analyze the benefit of reporting this measurement of downtime/availability versus simply measuring and reporting the true time that a work order is classified as "active" (not available to the customer). The method of availability/downtime reporting provided to customers should be based on providing the detail that meets their interpretation or expectation of downtime reporting as well as give a true indication of mission readiness of the fleet.

[8] Based on 390 units identified with availability requirements of 24 hours.

3.3.1.2 *Entering Vehicle Defect Requests into FASTER*

FASTER Service Center is a Web-based intranet access portal currently available to FEMS. It allows customers to reference historical maintenance and repair details about their assigned vehicles, monitor actual real-time work order statuses, report vehicle deficiencies, and request maintenance and repair appointments. This function is not being used by staff or FEMS customers, and it did not seem that the benefits of this module were known.

If the vehicle coordinators and operators used the deficiency reporting system provided by the FASTER Service Center, vehicle discrepancies would be captured early, allowing a more efficient scheduling window and accurate estimate of downtime, as well as providing advanced notification of parts requirements. The reporting capability also provides an audit for capturing the notification and correction cycles of deficiencies. The service coordinator or shift supervisor could provide electronic acknowledgement and feedback of the request. This would also afford the opportunity to schedule the vehicle service and to ensure parts and mechanic availability. Additionally, the system will automatically generate repair assignments from the queued deficiency list to the work order in FASTER. It is recommended that FEMS implement and utilize the FASTER Service Center so that vehicle deficiencies can be better reported to the AD.

3.3.2 Identification of Repair Task Codes

The following table shows a high-level analysis of the current repair code and their frequency of use on work orders. Of the 227 active major repair groups in the system, fewer than 10% of the repair groups accounted for more than 80% of all labor transactions and more than 83% of the total number of labor hours[9] for the past 6 months.

Repair code detail is reportedly difficult to navigate when trying to identify specialized groups of repairs. It was also reported that obsolete or excess repair detail in the coding lists complicates the repair schema. There are currently nearly 8,500 distinct repair codes in 227 major groups available in the system. This count is considered a medium/long list of codes that offer a wide range of intricate repair detail. Of these, only 1,315 codes have not been used to document a repair in the past 6 months.

Further analysis of the repair schema is warranted, since there is likely excess coding remaining in the repair list that either could be consolidated with other codes or eliminated from use. An appropriate repair listing allows the organization to identify trends and monitor activities without having to review every work order. The list must be detailed enough (in the proper areas) to provide accurate and comprehensive management reporting without adding unnecessary complexity that must be sorted through by the Shop staff that record the actual work.

[9] January 1, 2013 to June 30, 2013.

Table 12. Count of Repairs Completed by Type

REPAIR GROUP	COUNT	AVG LABOR COST	AVG LABOR HOURS	% OF TOTAL USED
PMA	460	116.5	2.9	8.8%
Brakes	401	128.5	3.2	7.6%
Body	374	103.8	2.5	7.1%
Charging System	354	120.6	3.0	6.7%
Cranking System	305	98.2	2.5	5.8%
Cooling Engine	266	121.3	2.9	5.1%
Cab	243	103.4	2.6	4.6%
Tire / Tube	239	151.1	3.7	4.5%
Light System	185	170.1	4.2	3.5%
Air Conditioning	176	126.7	3.2	3.3%
Air Supply	166	158.7	3.8	3.2%
Tow	165	123.7	3.2	3.1%
Steering	135	247.6	5.8	2.6%
Engine	134	119.6	2.9	2.6%
Fuel System	113	152.0	3.8	2.2%
PM7	95	220.4	5.5	1.8%
Transmission Auto	75	112.1	2.8	1.4%
Light Emergency	72	130.2	3.2	1.4%
Electrical Cycle	63	85.0	2.2	1.2%
Inspection	62	130.3	3.2	1.2%
PMX	56	200.9	5.0	1.1%
Exhaust Engine	55	127.6	3.1	1.0%
Electrical Accessory	53	91.9	2.4	1.0%
Aerial Equipment	52	123.7	3.1	1.0%
Hydraulic System	52	133.3	3.3	1.0%
Accessory	51	118.4	2.8	1.0%
Total Vehicle	51	113.4	2.7	1.0%
Engine Block	48	153.9	3.5	0.9%
Glass-Component	48	62.6	1.6	0.9%
Wheel / Rim	46	104.7	2.5	0.9%
Pump Industrial	42	135.8	3.4	0.8%
Tire / Wheel Cy	36	93.6	2.3	0.7%
Hose Emergency	34	321.2	8.0	0.6%
Drivability	32	54.1	1.4	0.6%
Suspension	30	170.7	4.1	0.6%
Lubrication	29	74.3	1.9	0.6%
Frame	28	119.3	3.0	0.5%
Welding	26	202.7	4.3	0.5%
Repair Code < 25	402	123.9	123.9	7.7%
TOTAL	**5254**			

Having this level of detail available for entry on work orders can reduce the accuracy of tracking activity instead of increasing the detail available. Repair schemas should support the activities of the maintenance and repair organization and the level of detail required for effective management reporting.

Because FEMS shares the repair code schema with two other agencies, it could be difficult to modify the structure to fit the specialty repairs needed to maintain fire apparatus and other fire specific equipment. With the exception of emergency hose and emergency light repairs in Table 12, there are no fire apparatus or specialty repairs listed. Examples of fire specialty repair codes that could be implemented and tracked are listed in Table 13.

Table 13. Examples of Fire Apparatus Specialty Repairs

REPAIR MAJOR GROUP	REPAIR COMPONENT	REPAIR MAJOR GROUP	REPAIR COMPONENT
Aerial Electrical Sys	Access/Brackets	Pumper Accessories	Deck Gun
Aerial Electrical Sys	High Idle Sys	Pumper Accessories	Water Level Sys
Aerial Electrical Sys	Tip/Nozzle Control	Pumper Accessories	Pump Test
Aerial Electrical Sys	Turntable Control	Pumper Accessories	Foam Controls
Aerial Electrical Sys	Proximity Switch	Pumper Accessories	Fire Commander
Pump & Plumbing	Discharge Valve	Pumper Accessories	CAFS system
Pump & Plumbing	Drain Valve	Light Emergency	Light Bar Assembly
Pump & Plumbing	Impeller	Aerial Truck Equip	Nozzle Control
Pump & Plumbing	Packing Gland	Aerial Truck Equip	Nozzle Electric
Pump & Plumbing	Priming Pump	Aerial Truck Equip	Torque Box
Pump & Plumbing	Relief Valve	Aerial Truck Equip	Override System
Pump Transmission	Manual Override	Aerial Truck Equip	PTO Pump
Pump Transmission	Output Shaft	Aerial Truck Equip	Turntable Control
Safety Interior	Seat Air Ride Assembly	Aerial Truck Equip	Basket
Safety Interior	Skate Seat Adjuster	Thermal Image Camera	Lens Cover
Safety Interior	Line Seat Air Regulator	Thermal Image Camera	Housing/Strap

3.3.2.1 *Repair Coding for Mobile Services*

FEMS operates a mobile service vehicle and several tow vehicles which provide both scheduled and emergency road service and road calls to customers. Currently, the repair coding scheme used for these repairs does not offer sufficient separation to be able to effectively identify the percentage of breakdowns versus scheduled services provided by the mobile service mechanic. Utilizing a different repair reason for a road service and a road call would give the level of separation needed to begin measuring this key performance indicator.

Another option for the mobile service vehicles would be to set them up with their own work order shop and storeroom identifier. This would have the benefit of allowing efficient monitoring of the operations of each of the service vehicles in the same way manner that "brick and mortar" shops can monitor shop loading and productivity. It would also allow direct

comparisons between mobile service vehicles and in-house facilities. The ability to transfer parts from the main storeroom into the mobile storeroom would allow the technician to issue parts directly to work orders and provide a tool to increase inventory accountability and flexibility.

3.3.3 Parts Management

FASTER has the capability of capturing all aspects of an enterprise parts operation including parts inventory and parts processing tasks. Currently most of FASTER's parts capabilities are not being used by FEMS staff. Parts are not ordered or received in the application. Rather, parts are ordered outside of the system, and parts inventory quantities are manually adjusted when new parts are received. Reorder information and inventory minimum/maximum levels are not set in FASTER, which prevents using the auto-order report or auto-order function.

The parts room is not secured, and technicians and supervisors research and pick their own parts. Issuance of parts to work orders is most often completed by the shop supervisors, though there are times when parts are issued simply on recognition of the job being performed with no accounting or conclusive evidence that a part was actually used during the task. This most often occurs in the morning, following the night shift.

Currently there is approximately $1.165 million in standing inventory, as shown in Table 14. Data were not available to be able to calculate parts obsolescence, parts turn ratios, or parts movement statistics. These metrics are all standardly employed in the fleet industry.

Table 14. On-Hand Parts Quantity and Cost

DISTINCT PARTS	QTY IN STOCK	ESTIMATED VALUE OF INVENTORY
5,323	41,029	$1,165,055

Because part orders or receipts are not entered into FASTER, staff cannot tell whether parts have been ordered for a specific job awaiting parts or awaiting scheduling for repairs.

The bar code functionality in FASTER is not being used to issue parts to work orders, even though a bar code label printer and bar code reader are available at the Shop. Part numbers for parts issued to work order are manually keyed into FASTER, creating a significant opportunity for data entry errors and the resulting inability to properly track parts costs to vehicles.

Parts warranties are not being entered and are not notated on the parts master record.

3.3.4 Discussion of FEMS' Use of FASTER

Overall, FEMS' current level of use of FASTER has been inefficient and inconsistent. FEMS is not following best practice expectations with regard to fleet information management. Several areas require a more detailed review to analyze data abnormalities and to develop options for a

more efficient coding structure or data normalization pattern. There are several processes that should be modified to ensure data integrity and ensure accurate detail.

There is no doubt that there are more complex or higher-level FMIS applications than FASTER available on the market. On the other hand, given FEMS' current data capture and work management practices and the lack of management reporting and performance indicator requests, the quality and capabilities of FASTER *far exceed* FEMS' immediate needs and requirements to adequately manage its maintenance operation using industry-accepted best practices.

Throughout the AD, there appears to be a lack of understanding of the benefits and capabilities of an automated FMIS application or the proper KPIs and management reporting that should be part of daily operations. The AD staff would benefit from fleet management training and FMIS training so that they can better understand why information should be captured, what data should be tracked, and how that data can be turned into invaluable fleet management information.

A more thorough comparison of FMIS functions to the determined future needs of FEMS management is included in Section 3.4.

We believe that the documented issues are "fixable." This conclusion is based on the seriousness of each gap and its impact on FEMS operation, as well as the estimated cost and timeframe to remedy the current issues using *FASTER C/S.*

3.3.5 Summary of Findings

15. FEMS has not identified and/or does not operate in accordance with a universally adopted set of organizational SOPs for fleet management. A lack of SOPs has caused notable inefficiencies, inconsistencies, conflicting management operation.
16. Continual process improvement has not been made a priority and as a result, several business processes are outdated or ineffective and need to be evaluated and redeveloped to leverage industry best practices and incorporate the use of fleet management information technology.
17. Cumbersome processes for managing workflow in FASTER for in-house and commercial repairs are slowing work order management.
18. Tight work order security settings are hindering the ability of service writers to close work orders, resulting in extended open repair transaction times, the inability to properly defer repairs (in some cases), and even the deletion of required repairs from work orders without that work being completed.
19. Data captured within work orders is of overall poor and inconsistent quality and quantity due to inconsistent coding, data capture methods, and noting of labor performed.
20. Vehicle downtime calculations are suspected to be understated as a result of the methodology for reporting fleet availability as opposed to downtime.

21. The FASTER Service Center function is not currently being used by staff or FEMS customers and the benefits of the tool are not acknowledged.
22. Excessive detail and inappropriate work codes (nearly 8,500 distinct repair codes) available for entry on work orders is suspected to be reducing the accuracy of activity tracking and adding unnecessary complexity to management reporting rather than increasing the detail recorded.
23. Repair coding for mobile services does not separate scheduled maintenance from breakdowns and, therefore, cannot be used as a key performance indicator.
24. FASTER is not currently being used for parts inventory and parts processing, including ordering, stocking, and parts movement. No apparent standard operating procedure, secure process, or consistent procedure is in place for any aspect of parts management.

3.3.6 Recommendations

14. Reevaluate and redevelop current business processes that are outdated and ineffective by leveraging industry best practices while maximizing the use of available fleet management information technology.
15. Map individual organizational work processes to include the use of a fully capable FMIS to manage the individual work procedures.
16. Correct repair deferral and closing function to avoid unintended deletion of open repairs from the work order during the closing process and to enable deferred repair tracking.
17. Modify the existing database trigger to restrict the inclusion of the walk-around inspection to only the maintenance shops that require that entry.
18. Redesign and restructure coded data elements used for assigned repairs and resulting labor transactions on work orders to ensure enough detail is available for follow up review and historical analysis without being burdensome on users.
19. Analyze the benefit of reporting measurement of downtime/availability versus simple measurement and reporting of true time a work order is classified as "active," to determine whether there are specific advantages of either reporting system that may lend to more accurate analysis.
20. Utilize FASTER Service Center to better report vehicle deficiencies to the AD and to provide departments with visibility of work history and current work order activity.
21. Revise repair coding to support the activities of the maintenance and repair organization and the level of detail required for effective management reporting.
22. Utilize a different repair reason for road service (i.e., scheduled repair) versus road calls (i.e., breakdown) provided by mobile services to more effectively measure KPIs for work performed by mobile service mechanics.

23. Designate a separate work order shop and storeroom identifier for mobile service vehicles to ensure efficient monitoring of the operations of each of the mobile service vehicles and to facilitate direct comparison with in-house facilities.
24. Utilize the bar code functionality in FASTER to issue parts to work orders.
25. Develop and conduct fleet management training in conjunction with FMIS training to promote staff buy-in to ensure improved information management, including reporting, data capturing and monitoring, and analysis.

3.4 Evaluation of Alternative Fleet Management Software

3.4.1 Overview

FEMS has been using the FASTER fleet management information system (FMIS) for more than eight years. To date, the system has not been used to its maximum potential. Business processes are not optimized and are not mapped into the FMIS for support of day-to-day operations and data collection. The staff is not familiar with the benefits of management reporting, trend analysis or performance monitoring.

Recently, FEMS has begun exploring alternatives to the current FMIS for management of its fleet operation. This report section outlines various FMIS options and provides a gap analysis between FEMS stated requirements and the leading candidate for system replacement as determined by FEMS: Chevin Fleet Solutions' FleetWave FMIS.

3.4.2 Commercial Off-the-Shelf (COTS) Systems

COTS solutions are commercially available FMIS applications developed to manage a wide variety of fleet operations from small fleets of several hundred units to large, diverse operations with tens of thousands of fleet assets. These systems can include specialized stand-alone management tools, such as motor pool dispatch and reservation software modules, telematics, and GPS-based systems, as well as fully integrated enterprise-level software programs.

Typical strengths and features of desirable FMIS, including nearly all of the "fleet-specific" applications, would include a high degree of compliance with the majority of these attributes:

- Web-based technology resulting in lower support costs with wider user accessibility.
- Complete life cycle management for vehicles, equipment, parts, and work orders.
- Comprehensive transactional details captured in sensible business driven processes.
- Ease of integration and interfacing with third party applications.
- Intuitive graphical user interface and consistent user experience throughout.

- Modern database and operating system compatibility increases security and data integrity.
- Code-based data capture provides consistent, reportable information and efficient grouping of details for reporting and analysis.
- Industry standard reports and ad hoc reporting engines allow effective data analysis for a wide user audience.
- Easy distribution of management information to enterprise customers through standard reports and dashboard tools.
- Efficient maintenance and shop operation management modules.
- Fully capable integrated parts management capabilities.
- Tight integration with fuel management, motor pool, telematics, and other third-party fleet specialty management modules.
- Flexibility and scalability to accommodate future technology and business process evolution and growth.

FMIS applications range in type from solutions that feature near-turnkey functionality, through robust fully configurable systems that feature moderate to fully customizable database, screens, and functional elements and objects. These systems generally fall into two broad categories – customizable (requires a level of screen design, function development and configuration) and out-of-the-box (OOB; characterized by a more rigid user interface and includes user-defined business rules built into the core application). System configuration, design, and follow-on administration is typically more complex for the customizable systems involving process definition and screen design compatibility, functional specifications and development, user security and permissions and integration of components within the application. OOB systems generally involve setting up pre-defined switches and options, code tables and user roles and security, since these systems often already include predefined processes and procedural functions. The leading systems accommodate nearly all information management needs, are aligned with best practice processes, include standard reports and analysis tools, all wrapped in fully integrated applications. Table 15 shows several differences between the OOB turnkey systems and the customizable systems.

Table 15. Out-of-the-Box versus Customized System Attributes

OOB	Customizable
Application business rules are built in to dictate how data is managed, processed, and validated.	Business rules must be incorporated into the system customization or configuration.
Standard designed screens, modules, and functions allow best practice fleet processes to occur.	Generally require a higher level of systems knowledge to configure and develop screens, functions and processes.
Include a set number of common asset schemas and data attribute listings.	Typically allows flexible data capture and nearly unlimited attribute tracking.
Generally more rigid in data capture and work flow processing management.	Allow options to accommodate non-standard business processes or alternate procedures.

The FASTER FMIS products are considered OOB applications, and the FleetWave product is a customizable solution.

3.4.2.1 *Considerations for COTS Applications*

Initial Cost – Systems are available as hosted software-as-a-service (SAAS) and as internally hosted applications. Costs are typically based on a per-unit or per-asset fee.

Ongoing Cost – Continuing costs for systems includes software and hardware maintenance and support, which is usually calculated at twenty percent of total software licensing and any provided customization.

Ability to Meet Requirements – COTS systems are fully capable of providing comprehensive fleet management functionality meeting all current needs and requirements for asset, maintenance, and inventory stock management for the FEMS fleet.

Ease of Acquisition – Usually a competitive Request for Proposal (RFP) and selection process would be required to define and procure these systems. Selection and implementation processes could take two years or more and the system could be introduced to the organization in phases.

Training and Support – On-site, process-based classroom training is typical and is usually provided in several stages. Fleet management and administrator training, key users, users, and go-live sessions are common. Complete user guides and online help are available.

Other – Systems generally keep pace with industry best practice and typically develop features and functions based on user request. Because there is a relatively large and educated user base for most of these systems, the software continues to evolve to meet those needs. We believe that a properly defined and configured FMIS solution would provide comprehensive capabilities as the FEMS FMIS. The best option for a solution would be to acquire a modular system that adjusts pricing and functionality based on specific requirements and not by adding additional customizations to a fully capable and robust system, which will be a much more costly alternative and perhaps would include functions and features that FEMS does not need.

3.4.3 Industry Cost Basis

The software industry has traditionally based its software license fees on two metrics:

1. the number of system users, and
2. the number of active assets in the system inventory.

With the advent of Web-based applications, vendor pricing for software licensing has shifted more towards using the metric of active asset count solely. This is largely attributable to their customers (i.e., fleet management operations) wanting to provide access to parts of the system to their customers (i.e., drivers and internal departments and divisions) to participate in the management of fleet assets.

Project implementation services are based on the scope of work defined by the organization purchasing the software, which is typically very weak. In fact, in many cases the organization will leave it up to the software vendor to determine an appropriate level of implementation services and budget to implement their software. Many times, the software vendor may propose a minimal level of implementation services – again to keep the total project price competitive.

Below is representative pricing for local installations. The examples are based on a 500-unit fleet and include vendor pricing for software license fees and basic implementation services.

Table 16. COTS Sample Pricing[10]

Vendor	Implementation Services	Software License	Project Budget
Vendor 1 – Semi Customizable	$70,000	$35,000	$105,000
Vendor 2 – Customizable	$79,000	$45,000	$124,000
Vendor 3 – Customizable Hosted	$75,000	$135 per user per month[11]	$75,000 + hosting fees

3.4.4 FEMS Needs and System Gaps

Based on information from interviews and details provided by staff and the FEMS IT section, Table 17 outlines the basic and optional system requirements and needs that FEMS desires in an FMIS. The ratings illustrate whether each system is fully compliant (C), partially compliant (P), not compliant (N), or available as a funded customization or future release (F).

[10] Monthly application hosting fees range from $.75 to $4.00+ per asset month or $55 to $350 per user per month, depending on the number of users, amortization options, and technical requirements.

[11] Based on 5-year agreement. Estimate includes software license, software annual support fees, and hosting services.

Table 17. FEMS Functional Requirements Analysis

FEMS REQUIREMENT	FASTER WIN	FLEETWAVE	FASTER WEB
Commercial-off-the-shelf (COTS) product	C	C	C
Accessible through standard browsers – no installation of additional client software	N	C	C
In production for at least five (5) years and used by at least ten (10) customers	C	C	N
Provides scalability	P	C	C
Maintain a comprehensive listing of fleet vehicles/equipment and their attributes			
Year	C	C	C
Make	C	C	C
Model	C	C	C
VIN	C	C	C
Department	C	C	C
Critical Use Parts List	P	C	P
Manages Maintenance and Repair	C	C	C
Preventative Maintenance	C	C	C
Corrective Maintenance	C	C	C
Predictive Maintenance	C	C	C
Emergency Maintenance	C	C	C
Inspections	C	C	C
Campaigns	C	C	C
Parts and Materials inventory management	C	C	C
Reorder inventory based on current balance/reorder points	C	C	C
Receiving of inventory	C	C	C
Re-stocking of storerooms(s)	C	C	C
Accommodates FIFO (first-in/first-out)	N	C	P
Track and report fleet availability	C	C	C
Evaluate performance, productivity, certifications and work quality of mechanics	P	C	C
Evaluate the performance, productivity and work quality of the overall operation	C	C	C
Manage warranties and support obtaining reimbursement	C	C	P
Capture fleet repair costs for chargeback to the department, manufacturer or vendor	C	C	C
Flag work order line items for incidences such as excessive wear and tear or unexpected repairs	C	C	C
Capture and track accident information and subsequent repairs including the ability to attach photos and police reports	P	C	P
Include repair cost estimates and subsequent approval of the estimates	C	C	N

FEMS REQUIREMENT	FASTER WIN	FLEETWAVE	FASTER WEB
Allow for acquisition, commissioning, de-commissioning, and disposal of fleet	C	C	C
Capture and track the cost of vehicle towing	C	C	C
Migrate legacy data from no more than four (4) years to the new system including but not limited to current inventory, FEMS' cost accounting convention, vehicles/equipment and their attributes, work orders and PMs	C	C	C
Provide for budgeting future capital investments (e.g., fleet replacement, new fleet, tool purchases, etc.) and operating expenses	C	C	C
Capable of attaching documents to assets, work orders, and other types of records (DWG, DWFX, DWF, GIF, PDF, JPG, PDF, TIF, DOC and XLS etc.)	P	P	P
Attach AutoCAD files depicting technical specifications of the vehicle and modifications made	N	N	N
Reports to include but not be limited to:			
Work orders and subsequent job tasks by vehicle	C	P	C
Detail and summary of open work orders	C	P	C
Detail and summary reports of closed work orders including root cause analysis grouped by month, vehicle type, department, etc.	C	P	C
Fleet usage reports by meter and cost by department, unit type and season	C	P	C
Forecasting and scheduling of coming due PMs by department	C	P	C
Comparison report showing the number of scheduled maintenance activities verses unscheduled maintenance activities (i.e., those without an appointment) and quick fixes	C	P	C
Exception reporting of work orders the costs of which exceed user-specified tolerance level compared to the cost estimate	C	P	C
PM and routine maintenance 1-year forecasting report	C	P	
Upcoming inspections listing report grouping each vehicle's inspection with its next quarterly PM	F	F	F
Technical specifications for vehicles including OEM maintenance recommendations	C	P	N
Vehicle maintenance history including upcoming scheduled maintenance and inspections due	C	P	C
Percentage of come-back repairs to the total number and total cost of repairs	C	P	C
Report to measure performance and productivity that includes but is not limited to the number of PM and maintenance work orders including associated job tasks completed against the service-level agreement based on a user-determined timeframe (i.e., month, year, etc.) broken down by technician, department, type of work, etc.	C	P	C

FEMS REQUIREMENT	FASTER WIN	FLEETWAVE	FASTER WEB
Report to identify campaigns and the vehicles, parts and costs associated with each	C	P	
Parts inventory listing reports including current balance of parts in stock, reorder points, minimum/maximum stock levels, and inventory valuation	C	P	C
Suggested reorder report that identifies parts whose current balance has fallen below the established reorder point. The report must also identify each part's lead time.	C	P	C
Cost accounting reports broken-down by department, unit type, vehicle class, work order, and by program (e.g., preventative maintenance, corrective maintenance, campaigns, recalls, re-repairs, warranty work, etc.)	C	P	C
Provides billing information on either a monthly or unit basis to report and recoup cost incurred by FEMS to repair damage to FEMS property and infrastructure	C	P	C
Reports metrics to benchmark internally and with other fleet departments	C	P	C
Miles driven (for vehicles with odometers)	C	P	C
Runtime hours for equipment with hour meters	C	P	C
Total fleet Maintenance, Repair, and Operations (MRO) cost per mile	C	P	C
Unit vehicle/equipment MRO cost per mile or hours	C	P	C
MRO cost per fleet class/class code per mile	C	P	C
MRO cost per fleet APWA codes per mile	C	P	C
PM cost per mile or hours	C	P	C
Fuel usage cost per mile or hours	C	P	C
Tire cost per mile	P	P	P
Fleet MRO cost per GVWR	P	P	P
Total cost of vehicle ownership	P	P	P
Return on investment of both fleet and the fleet management system	N	P	N
Capable of performing ad-hoc querying and reporting	P	P	C
Capable of exporting reports and queries to MS Excel/Word	P	P	C
Capturing, tracking and maintaining labor, parts, services and tool cost expended in support of fleet maintenance and repair including maintaining an audit trail of all expenditures	C	P	C
Captures the cost of changes to purchase orders that pertain to fleet against work orders	C	P	C
Capture the cost of equipment rentals against work orders	N	P	N
Graphical dashboard that, upon system log-in, lists KPIs as well as availability of priority vehicles/equipment by department, availability of priority vehicles by vehicle/equipment type, etc.	C	C	C
Ability to enter and track Material Safety Data Sheets	C	C	C
Ability to enter and track hazardous material disposal	N	P	N

FEMS REQUIREMENT	FASTER WIN	FLEETWAVE	FASTER WEB
Application Program Interface (API) for both the hosted and in-house versions of the system to allow customer-interfaces for importing data into and exporting data from the system	P	P	C
System's database schema accessible for developing reports and interfaces	C	P	C
Optional Elements			
Provide integration with FEMS' fuel card system (EJ Ward) and gas key VIT (Vehicle Identification Technology) System	F	F	F
Import data from the Department of Motor Vehicles. The data will consist of flat files and will include personnel name, driver's license #, type of license, vehicle class and an itemization of traffic violations, the type and date of each violation and the number of points against person's license.	F	F	F
Import itemized violations charged against vehicles by VIN and will include the type and date of each violation	F	F	F
Maintain key inventory	N	C	P
Vehicle diagnostics integration	F	F	F
Integration with FEMS' financial system	F	F	F
Integration with external vehicle valuation services (e.g., NADA)	F	F	F
Track shop tool/equipment inventory and manage the calibration of these assets	P	C	P
Track technical training completed by personnel and associated costs	N	C	P
Specify/design new vehicle/equipment	C	C	C
Includes motor pool management functions including a Web-based vehicle reservation application	C	C	N
Accommodates barcoded vehicles and work orders such that a technician can scan a work order and then scan the vehicle barcode and associate the vehicle to the work order electronically	C	C	C
Inventory management using barcode technology to issue/return items to work orders and to perform inventory cycle counts	C	C	C

3.4.5 System-Specific Information

The following sections detail information about the two systems profiled in this report.

3.4.5.1 *Chevin Fleet Solutions*

Chevin Fleet Solutions features two FMIS applications: RoadBase, a client/server application and FleetWave, a Web-based FMIS. As with the other first-tier applications, flexibility and the ability to accommodate existing fleet processes while supporting transitional and future options for fleet process growth are key attributes of the application.

3.4.5.1.1 FleetWave

FleetWave is a fully customizable FMIS that allows users to design, create and modify screens, database tables and features, etc. and can easily accommodate non-standard and non-traditional processes or requirements. The application is a comprehensive, flexible product capable of providing uniquely tailored solutions to meet specific client requirements including:

- Complete fleet management functions
- Comprehensive asset and fleet utilization management
- Flexible screen design supporting data capture of unlimited up-fit and serialized asset attributes
- Built-in Report Query Tool that will report on all data field within the system
- Consolidated integration to external information systems, procurement cards and suppliers
- Workshop, maintenance, personnel and inventory control
- Complete driver, accident and risk management
- Fully integrated fuel and external maintenance provider interfaces
- Flexible motor pool
- Inventory control and vendor system
- Web-based Intranet / Internet solutions
- Infinitely flexible solutions to suit client specific fleet requirements

Some of the high-level capabilities that FleetWave provides in a fully integrated enterprise fleet management system include:

- Comprehensive equipment/asset management functionality to capture, consolidate and distribute accurate real-time equipment related data
- Complete and totally flexible life cycle cost consolidation including maintenance, finance, fuel, comprehensive static and dynamic asset variables from acquisition through disposal
- Maintenance management tools to support internal and external vendor repairs
- Complete “Event Tracking” and compliance monitoring to include registration, license renewals, certifications, etc.
- Integrated data exchange/import capabilities with the EJ Ward fuel management system and bulk storage to accommodate complete fuel issue details

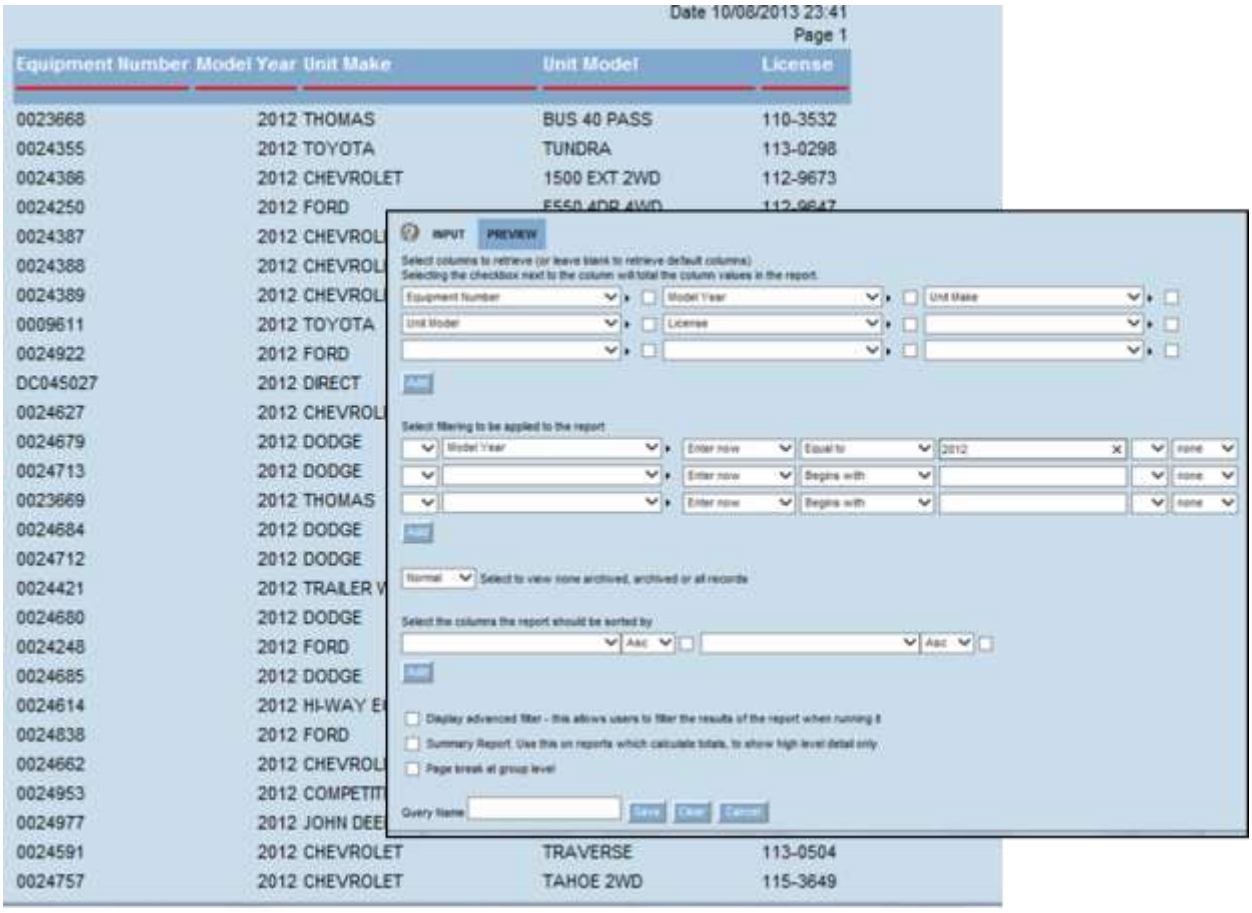
- Flexible and completely user-definable data capture of equipment as well as FEMS specific data elements to include real-time event management, predictive calculations and utilization statistics
- Integrated driver management tools to record and track complete driver compliance and assignment details
- Integrated accident and risk management capabilities including incident and operator details as well as collision, cost and subrogation tracking
- Integration with email for simple distribution of system generated reminders as well as business critical key performance data
- Infinitely flexible reporting and ad hoc query capabilities with simple export capabilities to industry leading spread sheet applications such as Excel
- The ability to add unlimited user-defined fields, attach documents, pictures, etc. to any screen within the system

Home Page KPIs, Lists and Management Reporting – FleetWave features a flexible and powerful fleet status tool, key performance indicator meters, charts and graphs and user defined lists and tables to display a snapshot of operations and statuses. The home page items can be deployed based on user roles, user accounts, or other groupings. FleetWave's Home Page dashboard allows organizations to create and deploy real-time "key performance indicator" reports, trend charts and color coded metrics to any user.

Figure 8. FleetWave Home Page – KPIs, Lists, and Status Tool

FleetWave also features comprehensive reporting functionality allowing users to easily access, sort, query and report on any data element captured within the system. Using the integrated Query Builder tool, users can easily create and save complex queries against any table using simple and intuitive "list of value" drop down boxes.

Figure 9. Ad Hoc Query Tool and Sample Report



Individual queries can be saved against a user's profile as well as opened and modified at a later date. Furthermore, any query or KPI that is centrally created and deployed to remote system users automatically leverages the users profile and language, presenting only the data that the user is authorized to view.

FleetWave is a true browser-accessible application requiring only Internet Explorer 7.0+ and supporting other industry leading browsers to access the full application from anywhere at any time. FleetWave operates in Windows Server 2003/2008/2012 environments running IIS 6, 7, 7.5. Database servers can be Windows 2005/2008/2012, UNIX, AIX, or Linux. FleetWave currently supports Microsoft SQL Server, Oracle, DB2 and other industry leading database licensing and operates in "virtualized" environments. The system also supports handheld and tablet devices.

3.4.5.2 *FASTER Asset Solutions*

FASTER Asset Solutions focuses solely on fleet management, and offers two leading FMIS applications: *FASTER* Win, a client/server architected application, and *FASTER* Web, a Web-based application. Both applications accommodate a variety of work processes to support variants of industry best practice management process and procedures for fleet organizations and feature tightly integrated and defined business processes controlling function in the application. An integrated motor pool module is available for the Win version. Customization is also available to integrate or interface with external third party systems. Both applications allow only limited user or vendor system and screen customization, but both offer flexibility through user defined setup and configuration options.

3.4.5.2.1 FASTER Win (no-cost upgrade) and Web (for cost) Versions

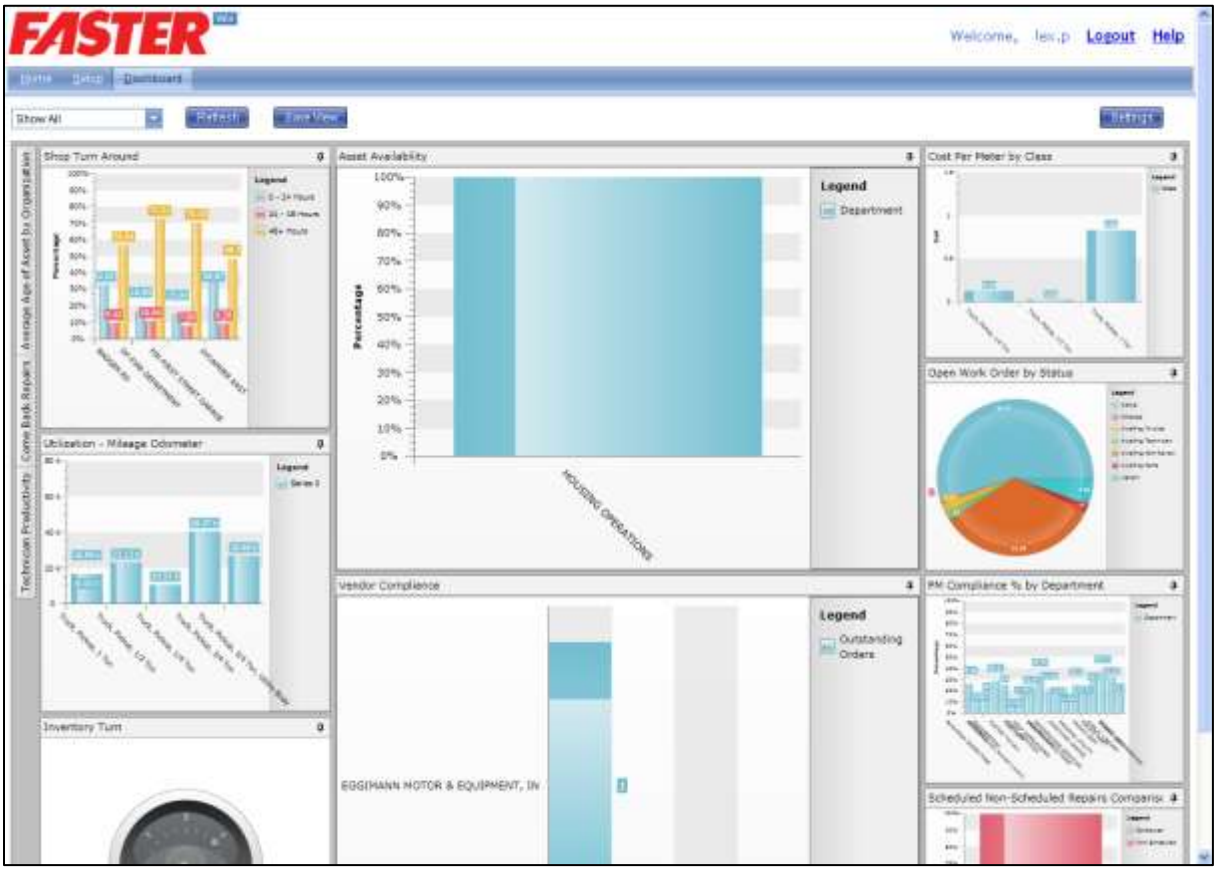
This section illustrates strengths and features of both the FASTER Win and FASTER Web FMIS versions providing fully featured comprehensive capabilities in the following areas:

- Asset Management from initial acquisition planning through disposal.
- Parts Inventory Management and Parts Tracking that encompasses the entire procurement process from order and receipt through issues including warranty replacements, core tracking/returns, and vendor credits through the accounting system.
- Maintenance and labor tracking based on work order process flow including customer service tools that enable higher levels of service and preventative maintenance tools for managing PM's.
- Flexible Accounting and Billing – Tracking of all costs and vendors related to assets as well as billable dollars and customer accounts.
- Fuel Management with the ability to collect and store fuel transactions by manual process, electronic upload or integrated web services depending on the capabilities of your fuel provider.
- Robust and flexible System Administration and Usability features are incorporated throughout the *FASTER* system.

The Web Solution is intended to fulfill the need of those organizations that require the benefits of a browser based client that can be accessed from remote locations with any wireless enabled device. The Windows-based solution, FASTER Win provides a solution for those who prefer a non-Web-based platform

Dashboard and Reporting – The FASTER WIN and FASTER Web applications include a dashboard tool (KPIs) that features a core set of industry performance metrics.

Figure 10. Dashboard Example



A review of the available KPIs and documentation identifies a sound group of selected measures recognized in the fleet industry as valuable for assessing effectiveness of operations. Each of these measures has an industry standard metric for benchmarking, but an organization can also develop their own set of acceptable thresholds for measuring efficiency and effectiveness. The core KPIs included in the application include:

- Asset Availability (downtime)
- Shop Turn Around
- PM Compliance
- Cost Per Meter
- Utilization
- Open WO by Status
- Technicians Productivity
- Scheduled/Non-Scheduled Repairs Comparison
- Comeback Repairs

- Vendor Compliance
- Inventory Turns
- Average Age of Asset

This tool is available if DPW updates the current version to FASTER Win (a no-cost upgrade) and will also be available if DPW upgrades to the FASTER Web version (an at-cost upgrade). The applicability for each management group's use of the individual KPIs should be determined since all KPIs are not interchangeably beneficial to be used by all areas of an operation.

A robust set of standard management reports are provided as part of the both core FMIS applications. These reports are useful to provide the background details for the KPIs discussed above, supply additional performance analysis, present business intelligence findings and supply the basis for management decisions. The reporting engine used in the current version is based on Crystal Reports and in the FASTER Web product, is a tool integrated in the *MS SQL* database management system and provides an ad hoc, on demand, web-distributed reporting solution. The latest reporting solution is ideal for distributing reports to internal FEMS staff, AD customers, and FEMS management staff. The reporting tool allows easy modification and customizing of the standard provided reports and creation and distribution of new user-developed reports.

FASTER Web is a Web-based application that utilizes the following technologies:

- IIS
- ASP.NET
- Silverlight
- SQL Server
- SQL Server Reporting Services
- The .NET Framework

The application is designed using the CSLA .NET framework, which allows for 1, 2, and n-tier deployments. CSLA .NET also provides the flexibility to optimize performance, scalability, security and fault tolerance with no changes to code in the UI or business objects, thus providing a flexible system using industry standard platforms with low cost of maintenance and operation.

3.4.5.3 *Common System Traits*

As shown in the requirements and features matrix presented in Table 17, both FMIS Vendor options meet the majority of identified core needs expressed by FEMS. Furthermore, each contains optional features, add-ons and interface possibilities to increase the future flexibility of the applications and the likelihood of satisfying future process growth within FEMS.

The general native functions and management capabilities between the FMIS applications are quite similar, and most feature an equitable level of fully functioned integrated management tools. The differentiating factors between the available applications usually follow optional functionality or available add-on modules, availability of customization and user defined capabilities of the applications.

Regardless of pricing level, any considered FMIS solution should offer fully integrated fleet management capabilities with the same basic data capture flexibility, real time information access, ad hoc reporting capabilities, key performance indicators, work management and scheduling, notification functions, trend and cost analysis and feature distributable information.

Making reports and key performance indicators available online to demonstrate service level statistics and performance ratings is an efficient method of 'advertising' the fleet's benefits to its customers. Additionally, providing a current snapshot of operations (e.g., work in progress, vehicle history, and completed work) allows customers to monitor the readiness of their vehicles without having to contact the fleet department for status while allowing customers to track maintenance and repair costs.

Even though an automated, integrated system is crucial to proper fleet management, a system should not 'drive' the proper function and operational practices of an organization. Capturing data just for the sake of data capture is generally a time consuming and futile effort with resources that could be allocated more effectively. Capturing the right data with the proper processes to provide meaningful and accurate information is the key to effectively utilizing a fully functioned FMIS.

3.4.6 Implementation Planning

The implementation phase and its related tasks should be the most important and complex task of transitioning to a new FMIS. Moreover, it must be understood that an FMIS is a tool to be leveraged to manage complex business procedures effectively and not simply a container to capture data and report information. With that in mind, systems that are not a fit with existing processes or plans for improvement will not be well accepted and will have an adverse effect on the information being collected, the day-to-day operational processes and the resulting reporting and analysis capabilities.

Experience in FMIS deployment has shown that the most successful system projects are based on a solid application, but more importantly on a comprehensive, tailored implementation plan coupled with extensive services and training. An understanding of the operational processes and needs of organizations and creating a solution to fill those needs will ensure buy-in from all levels of system users and provide an effective management and reporting tool.

The phases or steps of a successful implementation plan must lead to proper system configuration, setup and process engineering that will provide a solid baseline for a successful transition and enable effective and efficient data collection, analysis, and reporting technologies.

The typical steps in a comprehensive implementation phase include:

- **Pre-Planning and Process Review** – this step is instrumental in fully understanding current operations, to formulate the transition plan requirements (system codification plans, conversion decisions, training requirements, special conditions to accommodate and interfaces with existing systems, etc.). This discovery phase will allow the system provider to share the vision of what the complete solution should look like at the end of the initial implementation and even into the future expansion and enhancement of the application and the organization.
- **Data Conversion and Data Mapping** – acquiring, review, and normalization of customer data must be completed prior to mapping existing data to the new FMIS-specific fields, tables, and coding structures. This step takes existing data and creates usable effective data sets in the new application. This can include combining data from multiple systems, sources, and structures into a cohesive presentation.
- **System Setup, Configuration, and Codification** – A modern FMIS includes various code sets to support vehicle classifications, repair schema, fuel types, etc. and user accounts, security profiles, etc. This step ensures that all options and variables are explored and outlined for the customer and decisions made to provide the optimal system setup and functionality for individual customers.
- **Reporting and Performance Indicators** – Standard and optional reports and analysis tools are reviewed with the client and any specific reports, or data extracts are defined and scheduled for development or configuration.
- **Management and User Training** – Typical training includes administrator, key user, and individual user training sessions. Each session is presented by user role and responsibility so that each user understands their role in the information management scheme as well as the practical instruction on how to use the system to conduct daily processes and procedures. There are usually introductory user and pre-production sessions offered throughout the implementation timeline.
- **Continued Management and System Support** – Once the data conversions are complete, the system is completely configured, users are trained, and the system is moved into production, the final phase begins. This phase includes continued management training and process and systems support.

3.4.7 Considerations for Technology Enhancements

3.4.7.1 *GPS and Telematics*

GPS and telematics solutions provide automatic vehicle location services and can provide vehicle maintenance and operational details. Commercial vendors provide state- of-the-industry solutions in the telematics field, and nearly all provide an effective data feed to allow incorporation into FMIS and other management systems. A standard data import strategy can be used to interface with vendor's solutions and include the ability to translate various code sets into a consistent, normalized data stream and to capture hour and odometer meter readings.

Both FMIS vendors acknowledge current customers using GPS and Telematics solutions and the capabilities of interfacing with this technology to collect fault codes, odometer and hour meter readings, vehicle operation codes, etc. but currently are not aware of any customers interfacing this data into the FMIS.

3.4.7.2 *Automated Vehicle Inspection Technology*

As outlined Section 6.1, operators are tasked with performing daily inspections at the beginning of each shift (so-called "DOT pre-trip inspections"). It was reported that these inspections are not properly documented and in some cases are not conducted properly. The ZONAR Systems Electronic Vehicle Inspection Report system (EVIR) is a patented visual inspection system that verifies the inspector is in physical proximity to the area of the vehicle being inspected. This system could be used to ensure compliance with required daily vehicle inspections.

With the ZONAR system, radio-frequency identification (RFID) tags are placed on the vehicle in critical inspection "zones." Using a ZONAR handheld device, the operator is guided step-by-step through the customer-defined inspection checklist. The inspector can only mark a checklist item as complete if the device senses that it is in the appropriate "zone." Defects are reported using a menu of predetermined, validated choices, ensuring that the data being collected are accurate, descriptive, and reportable. When defective components are discovered, the driver selects the defect description and indicates whether the vehicle is safe to operate. When the inspection is complete, the data are wirelessly transmitted to a secure database.

Through a real-time integration to the FMIS, defects identified using a ZONAR handheld device can be automatically added as service requests, or deferred repairs. The system can be configured to provide management alerts through a KPI or home page list and when the vehicle is presented at the shop for service or repair, the department has already been alerted to the necessary repairs, allowing efficient work scheduling and dramatically reducing vehicle downtime.

Once the defect has been resolved, status updates can be sent to the ZONAR EVIR® database where all defects are also tracked, simplifying DOT and local audits and reports.

FASTER and Chevin acknowledge current integrations with the ZONAR EVIR system.

3.4.7.3 *Communications and Telemetry Platform*

FEMS is preparing to undertake a pilot project with a technology partner, In Motion Technology, to implement a communications and telemetry platform in frontline apparatus and EMS units.

3.4.7.3.1 Communications Platform

The onBoard™ Mobile Gateway (oMG) is a multi-network, rugged communications platform designed to deliver secure, wireless wide area networking for vehicles. The oMG extends the enterprise network and management to the fleet, ensuring reliable, secure corporate network access for mobile users in the field. The oMG functions as a multi-radio mobile router and broadband access point and can be configured with multiple wireless modems that provide access to a combination of cellular data, 802.11 a/b/g/n Wi-Fi, 4.9 GHz broadband, carrier 4G LTE, public safety broadband LTE (FirstNet), and other broadband network services. It features a built-in GPS receiver and microcomputer, supporting applications such as vehicle tracking, RFID asset tracking, vehicle telemetry, and remote device access.

Remote management of the oMG is provided by the onBoard™ Mobility Manager (oMM), a powerful software suite that provides status monitoring, device management, and application interfaces. A dashboard provides an up-to-date view of the entire fleet, and a comprehensive reporting suite presents data on-demand or via pre-scheduled reports.

3.4.7.3.2 Host Applications

In Motion Technology applications include:

- GPS vehicle tracking
- Asset tracking of RFID Wi-Fi tags
- Vehicle diagnostic telemetry via OBDII
- Remote device trouble-shooting
- Turn-by-turn navigation via Garmin Fleet Management Interface

3.4.7.3.3 Embedded Telematics Application

onBoard™ Telemetry enables organizations to monitor the performance and health of their fleet in real-time from any location using an embedded telematics application. Dispatchers can monitor specific vehicles and get detailed information about odometer, coolant temperature, battery voltage, diagnostic trouble codes, fuel levels and more. Combined with powerful reporting capabilities, this can help reduce fuel consumption, eliminate unauthorized usage of vehicles, and improve driver safety.

Table 18. onBoard™ Telemetry Diagnostics Options

Ambient Air Temperature	Battery voltage
Brake Fluid Level	Calculated Load Value
Diagnostic Trouble Code	Distance/time since MIL light on
Engine Coolant Temp	Engine RPM
Engine run time	Fuel level (%)
Fuel Rail Pressure Gauge	Malfunction Indicator Lamp (MIL)
Odometer	Time since engine start
Total Distance	Vehicle Speed
VIN	

onBoard™ Telemetry collects diagnostics continuously from each vehicle which can be presented to the fleet staff based on defined policies for data collection as reports, automated email and alerts. By integrating this diagnostic data with the FMIS, fleet management will have advance notice of defects and faults and can proactively schedule remedial repairs or defer the corrective action for when the unit is next available for service or repair. onBoard™ Telemetry data provides fleet management and maintenance staff a comprehensive view of vehicle status in order to reduce or eliminate breakdowns in the field.

Both FMIS vendors acknowledge the possibilities of interfacing with the INMOTION Technology telemetry and other embedded applications to collect fault codes, odometer and hour meter readings, vehicle operation codes, etc. but currently are not aware of any customers utilizing this vendor technology or interfacing this data into the FMIS.

3.4.8 Hosted Versus Internal Deployments

In addition to application choices, deployment methods or system architecture can also affect user access and information disbursement. The primary architecture selections are client/server, web based and hosted applications. Overall, Web-based and hosted solutions benefit deployments with remote or satellite locations, operations with high user counts and mobile or remotely connected users. Web based and hosted applications typically require less administration and management of the application and updates and patches are easily applied since the application resides on single or clustered web servers. In addition to basic application access, some hosting solutions provide a reduced cost over purchasing licensing, offer additional system administration or data analysis services. Most all current client/server architecture systems include web-enabled modules that allow online work requests, work order status reviews and other limited functionality typically for access by non-fleet customers.

Hosted systems include the data processing platform on which software applications run and provide associated support services on a subscription basis. Hosted solutions allow organizations to use limited resources to produce and use information without having to maintain systems, thus increasing the return on investment on information technology expenditures.

Organizations select hosted solutions to:

- Take advantage of state-of-the art management information systems that they otherwise might not be able to afford
- Avoid large up-front hardware and software costs
- Obtain better service
- Leverage core competencies and focus on their core mission
- Maintain autonomy
- Improve access to and the distribution of management information

The following illustrates some of the benefits of acquiring a hosted solution:

Affordability

- No local server platform required
- Minimal IT department assistance required
- Minimal workstation infrastructure required
- No software license fees
- Simpler implementation process
- Predictable FMIS costs

Speed

- Platform already in place
- No waiting for server hardware or software to be purchased, installed, configured, or tested
- Software modifications, bug fixes, new releases installed immediately and seamlessly
- System response time exceeds that of many local platforms

Accessibility

- Hosted solutions are available anywhere, everywhere and anytime an Internet connection is available
- At work, at home, on the road
- Via PC
- Via Winterm
- Via Tablet PC

Security

- Multiple layers of data encryption
- Complete database backup and disaster recovery procedures
- Anti-virus protection
- Closed-loop broadband connections available
- VLAN available

Support

- All OS, DB, and application software updates
- Security patches
- Anti-virus definition updates
- Network performance tuning and troubleshooting
- Help desk and on-line tools
- Dedicated fleet management support professionals

3.4.9 Analysis of FASTER Versus Possible Alternatives

FEMS' currently used FMIS product, FASTER C/S, fulfills the majority of requirements that FEMS has determined are critical to the operation, although several concerns must still be addressed – including current system utilization, access and support, and future system upgrades and functionality paths – in order to recognize maximum benefit from the application.

Several constraints of FASTER's deployment in D.C. Government must be considered in order to determine whether to procure a new system or to retool the existing operational processes and procedures using FASTER:

1. The system is hosted by another District agency (i.e., DPW).
2. The system configuration and setup are shared amongst three dissimilar agencies, preventing fully optimal utilization conditions for any.
3. The system upgrade path has not yet been determined to fully meet FEMS requirements or needs.
4. FASTER Web functionality, features, and use are not consistent with the existing FMIS version, which may require change in FEMS operation and procedures.
5. Complaints exist about poor system performance and inconsistent access.
6. The client/server architecture restricts easy access.

These constraints primarily concern system support and access issues, but they should also be considered in relation to different application functionality if FASTER C/S is upgraded to the FASTER Web product.

Irrespective of whether FEMS chooses to acquire a new FMIS or pursue configuration and reimplementation of FASTER, the Department must ensure that the core deficiency issues outlined in Sections 3.1 to 3.3 are corrected. Procuring a full-featured, robust fleet management system will not guarantee an effective solution *unless* the application is properly implemented, necessary data are properly entered, and the system used consistently throughout the organization to capture the proper data and provide accurate management information and information transparency while satisfying daily best practice management procedures.

The issue of system upgrade and the timing for needed fleet management and FMIS training should also be considered when determining the most appropriate FMIS path for FEMS. Upgrading to the FASTER Web product will require considerable data and staff review and management. Because the latest version of FASTER is actually a new application, the user interface, functionality and features – while similar to existing FMIS – are at the same time, substantially different. Data conversion, system codification and setup, user training, and process mapping will all need to occur whether FEMS decides to continue teaming with DPW and upgrades to the FASTER Web product, or splits from DPW and selects an agency-specific FMIS. Furthermore, because the upgrade is at a cost, it has not yet been determined whether DPW will upgrade as sole source procurement, or be required to go to bid for evaluation of the FMIS upgrade. It is also not currently known what the financial requirement to FEMS would be for upgrade of the FMIS software and the upgrade of the current hosting infrastructure to support the new system architecture.

3.4.10 Summary of Findings

25. FEMS' current product, FASTER C/S, provides the majority of requirements that FEMS has determined are critical to the operation, although several concerns must still be addressed, including current system utilization, in order to derive maximum benefit from the application.
26. There are issues with the deployment of FASTER C/S that should be considered/resolved making a decision about whether to procure a new system or to retool the existing operational processes and procedures for using FASTER.
27. A hosted solution offers many benefits, including improved affordability, speed, accessibility, security, and support.

3.4.11 Recommendations

26. System upgrades required by DPW and the timing for needed fleet management and FMIS training should be considered when determining the most appropriate FMIS path for FEMS.
27. Determine whether to procure a new system or to retool the existing operational processes and procedures currently in place using the FASTER system.

If FEMS chooses to continue using the existing FASTER system:

28. Better utilize functions offered by the FASTER system, as described within specific recommendations in Sections 3.2.5 and 3.3.6.
29. Systematically work to address constraints found within FASTER as currently deployed.
30. Address the core deficiency issues shown as "N" or "P" in Table 17.

If FEMS chooses to procure a new system:

31. FEMS must consider initial cost, ongoing cost, ability to meet requirements, ease of acquisition, and training and support, when considering COTS applications

When implementing a new system:

32. Ensure successful implementation by developing a comprehensive tailored implementation plan and extensive services and training.
33. Apply new system with attention to configuration and process engineering that will provide a solid baseline for a successful transition and enable effective and efficient data collection, analysis, and reporting technologies.
34. Select and implement technology solutions to fill existing procedural gaps integrating these tools with the FMIS to provide a single reporting and management platform.

SECTION 4. FLEET COMPOSITION

This section discusses the composition and condition of the current fleet, reserve fleet requirements, and apparatus replacement.

4.1 Inventory of the Current Fleet

A methodical inventory of the entire FEMS fleet was conducted as part of this study. This inventory was crucial to establishing baseline information about the composition and condition of the fleet.

4.1.1 Overview of the Apparatus Inventory

The apparatus inventory the Project Team conducted revealed a fleet that is aging, showing signs of excessive wear-and-tear, and in overall poor condition that is reflective of years of hard, urban emergency driving compounded by unstructured and deferred preventative maintenance and repairs. As one might expect, newer apparatus were found to be generally in better shape than older apparatus, but even newer apparatus often had maintenance issues. Some apparatus appeared to be well-maintained and were in good shape in spite of their age (e.g., Engine 23), but this seems to be a function of the pride and diligence of the firefighters at a given station.

The FEMS Fleet is composed of 369 vehicles and other motorized and non-motorized equipment for which the AD is responsible, as shown in Table 19.

Table 19. Composition of the FEMS Fleet

TYPE	TOTAL	FRONTLINE	RESERVE
Engine Companies	53	33	20
Truck Companies	26	16	10
Squads/HazMats[12]	9	6	3
EMS Transport Vehicles	93	38	55
Light Duty/Other[13]	143	126	17
Specialty Vehicles[14]	45	45	0
TOTAL	**369**	**264**	**105**

In addition FEMS leases 42 passenger vehicles from the U.S. Government's General Services Administration (GSA). These vehicles are maintained by GSA, not FEMS.

[12] Includes Rescue Squads, Hazardous Materials Units, and the Critical Incident Support Unit, but does not include any light-duty support vehicles for those units (those are counted under Specialty Vehicles).

[13] Includes command and support vehicles (e.g., SUVs and passenger cars and vans) as well as utility and other unclassified vehicles (e.g., forklifts, Segways, and riding mowers).

[14] Includes emergency apparatus which fill special response purposes. Some specialty units are motorized (e.g., the lumber truck for the Cave-In Unit, waterborne apparatus), and some are trailers. Also includes one antique fire engine, which is owned and maintained by the Department, but which fills only a ceremonial role.

4.1.2 Assessment of Apparatus by Type

Following is an assessment of the FEMS fleet inventory, considering factors such as age, mileage, engine hours (where applicable), and overall physical and engine conditions for each class of apparatus, as determined during the course of the Project Team's physical inventory.

4.1.2.1 *Approach to Rating Apparatus*

The Project Team conducted the apparatus inventory by collecting essential, quantitative data on each vehicle inventoried, including:

- Station information and Unit ID
- Vehicle serial number, VIN, manufacturer and year built
- Apparatus type and status
- Mileage and engine hours

Since there is no widely accepted fire/EMS industry standard for rating apparatus condition, assessment of the condition of each vehicle involved more subjective interviewing during which we sought the opinions of the personnel who drive and ride the vehicles on a daily basis. The Project Team considered the following areas when performing qualitative assessment of apparatus:

- Physical condition of each unit
- Driver's report of the condition and performance of the unit's engine
- Driver's report of the ability of the unit to climb hills, stop abruptly, accelerate, etc.
- Driver's report of any current malfunctions, including air conditioning, leakages, etc.

In order to gather qualitative inventory data on the physical condition of the apparatus as described above, we combined the users' ratings with our professional (albeit subjective) opinion based on a brief visual inspection of the apparatus. As discussed in Section 2.4, we specifically and intentionally did not attempt to rate vehicles using objective mechanical criteria. To do so would have been beyond the technical capabilities of the Project Team and would not have been feasible given either the Scope of Work or the timeline for completing this study. Finally, it was not within our purview for this study to deem a vehicle mechanically unfit or attempt to put a vehicle out of service for any reason. This review is a quantitative and qualitative assessment of the current status of the FEMS fleet and is not intended to serve or double as a safety and maintenance inspection. Had we encountered a vehicle which we believed was unsafe to the point that it should have been put out of service on the spot, we would have notified the FEMS Project Manager immediately. We did not need to do this.

In reviewing the assessments that follow, the lay reader is cautioned not to interpret a rating of "Good" to mean that a piece of apparatus is problem-free. Apparatus subjectively rated as "Good" can still suffer from a wide range of problems that can interfere with smooth operations. Indeed, many of the apparatus that were rated "Good" had chronic defects or issues that hamper day-to-day operations, but they received a "Good" rating simply because their operators didn't have a means to differentiate adequately between "Good" and the ratings on either side.

In the emergency services business, apparatus should routinely be classified as "Excellent" or "Very Good" (represented in blue in the charts that follow). The best way to understand this is to draw an analogy to a commercial airliner. Would the average person be comfortable flying on a jet rated "Good" or would that person really want that plane to be rated "Excellent" or (at least) "Very Good"? In a business where the ability to pump water to a fire, raise a ladder to the roof of a burning building, or get a critical patient to the hospital depends 100% on the condition of the apparatus, "Good" isn't very much better than "Fair" or "Poor."

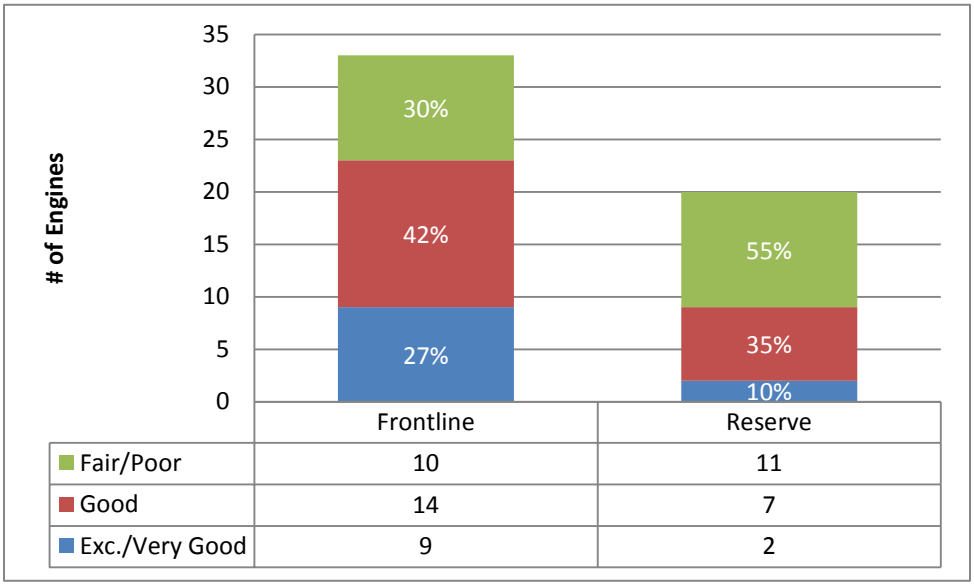
Some vehicles are in "Good" physical condition or have "Good" engines, but are bare-bones from the standpoint of user comfort because seats are missing or damaged. A frequent complaint about apparatus (both fire and EMS vehicles) was that they had air leaks. This means that these vehicles must idle for as much as two minutes before sufficient air pressure can be built up to ensure that the brakes will work (a lot of heavy duty apparatus use air brakes) or that the Air Ride suspension system (used in many ambulances) will work. Can these vehicles squeak by? Yes. Are they optimal in terms of safety, reliability, comfort, etc.? No. For example, there are numerous ambulances which are in decent physical condition and which run, but which lack reliable air conditioning. In the heat of a Washington, DC summer, it is simply <u>not</u> acceptable to not have air conditioning in an ambulance.

4.1.2.2 *Engine Companies*

The FEMS fleet includes 53 engine companies (fire pumpers), 33 of which are considered frontline apparatus. The average frontline engine is 7 years old and has logged 62,784 miles (8,817 miles/year) and 6,243 engine hours (828 engine hours/year). The average reserve engine is 11 years old and has logged 69,197 miles (6,154 miles/year) and 9,788 engine hours (841 engine hours/year).

The Project Team's qualitative assessment of engine companies' physical condition was that 27% of frontline engines and 10% of reserve engines were rated either in "Excellent" or "Very Good" condition (blue in the chart below), 42% of frontline engines and 35% of reserve engines were rated "Good" (red in the chart), and 30% of frontline engines and 55% of reserve engines were rated either in "Fair" or "Poor" condition (green in the chart).

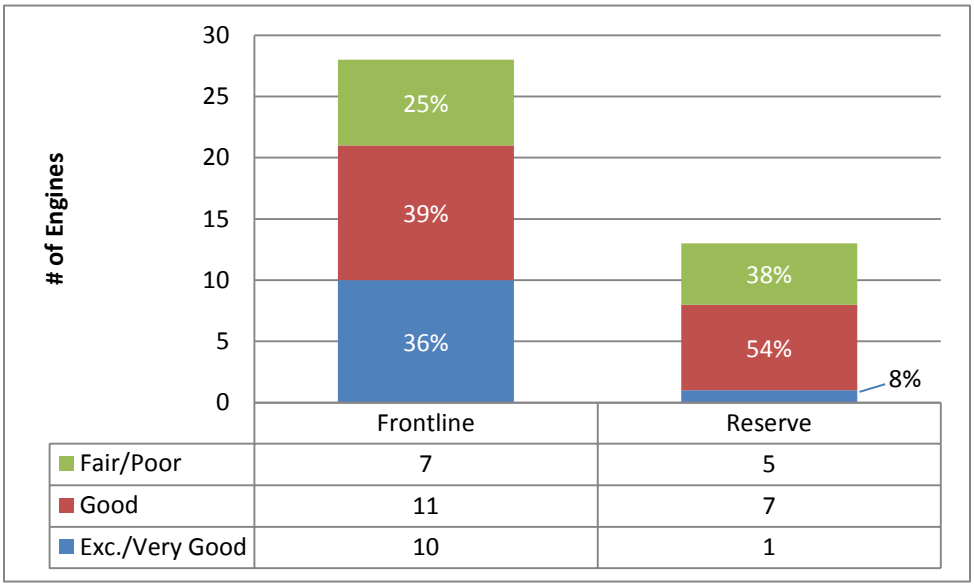
Figure 11. Physical Condition of Engine Companies



	Frontline	Reserve
Fair/Poor	10	11
Good	14	7
Exc./Very Good	9	2

The Project Team's qualitative assessment of engine companies' engine condition was that 36% of frontline engines and 8% of reserve engines were rated either in "Excellent" or "Very Good" condition (blue in the chart below), 39% of frontline engines and 54% of reserve engines were rated "Good" (red in the chart), and 25% of frontline engines and 38% of reserve engines were rated either in "Fair" or "Poor" condition (green in the chart).

Figure 12. Engine Condition of Engine Companies



	Frontline	Reserve
Fair/Poor	7	5
Good	11	7
Exc./Very Good	10	1

The engine companies of the FEMS fleet put in long hours and many miles. While the frontline units are in passable condition, the reserve units are, by and large, unreliable. Of the 53 engines

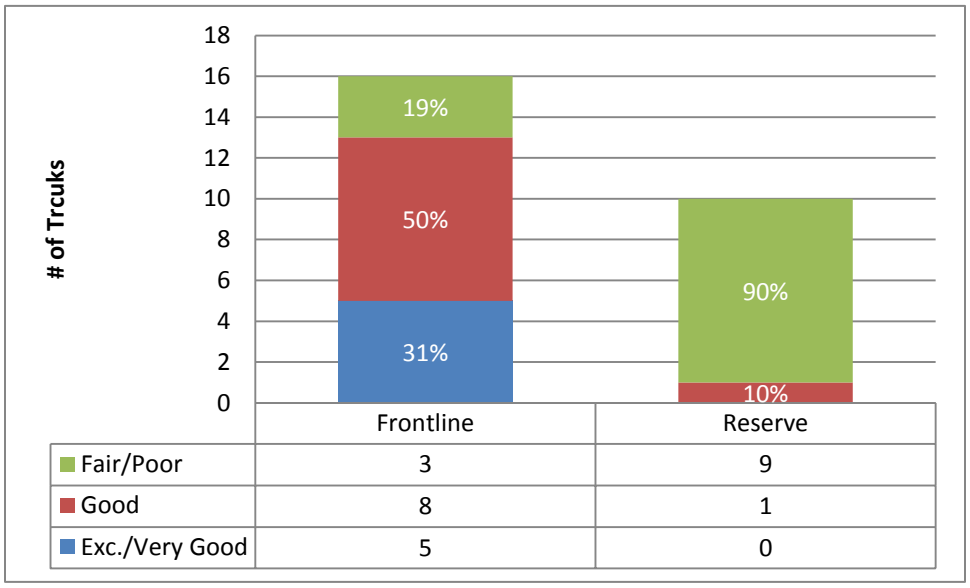
in the FEMS fleet, 49 of them had multiple work orders within the same repair group[15] submitted in the first 6 months of 2013. One unit had 46 work orders submitted during that period.

4.1.2.3 *Truck Companies*

The FEMS fleet includes 26 aerial apparatus (truck companies), 16 of which are considered frontline apparatus. The average frontline truck is 7 years old and has logged 42,284 miles (5,967 miles/year) and 5,823 engine hours (917 engine hours/year). The average reserve truck is 13 years old and has logged 55,730 miles (4,255 miles/year) and 8,296 engine hours (629 engine hours/year).

The Project Team's qualitative assessment of truck companies' physical condition was that 31% of frontline trucks and no reserve trucks were rated either in "Excellent" or "Very Good" condition (blue in the chart below), 50% of frontline trucks and 10% of reserve trucks were rated "Good" (red in the chart), and 19% of frontline trucks and 90% of reserve trucks were rated either in "Fair" or "Poor" condition (green in the chart).

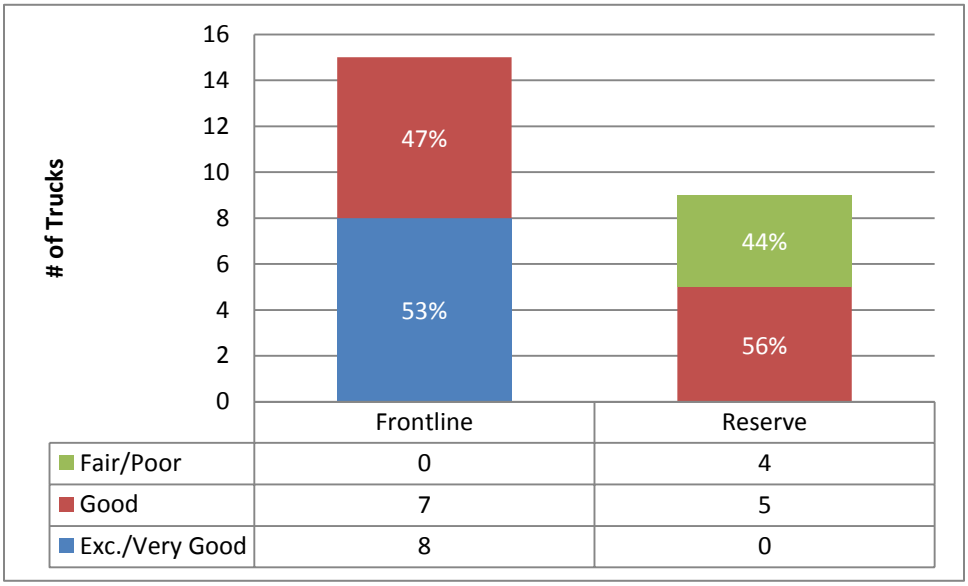
Figure 13. Physical Condition of Truck Companies



The Project Team's qualitative assessment of truck companies' engine condition was that 53% of frontline trucks and no reserve trucks were rated either in "Excellent" or "Very Good" condition (blue in the chart below), 47% of frontline trucks and 56% of reserve trucks were rated "Good" (red in the chart), and no frontline trucks and 44% of reserve trucks were rated either in "Fair" or "Poor" condition (green in the chart).

[15] A "repair group" is a top-level classification of repair, such as "brakes" or "air conditioning." FASTER contains more granular work order information than repair group; however, it is not necessary to analyze these lower levels of detail because when a work order is submitted, all possible conditions in the repair group should be checked by the mechanic before certifying that the repair has been completed. Recurrent work orders within a repair group are indicative of either greater problems with the vehicle or poor repair practices.

Figure 14. Engine Condition of Truck Companies



As with engine companies, FEMS truck companies are worked hard. Frontline truck companies are in comparatively better shape than frontline engine companies. This is probably due to the fact that truck companies run less than engine companies. Unfortunately, while frontline trucks are in decent shape, the reserve trucks are in pretty bad condition. All 26 trucks in the fleet had multiple work orders within a repair group submitted in the first 6 months of 2013. The highest number of work orders submitted for a single unit during that period was 45.

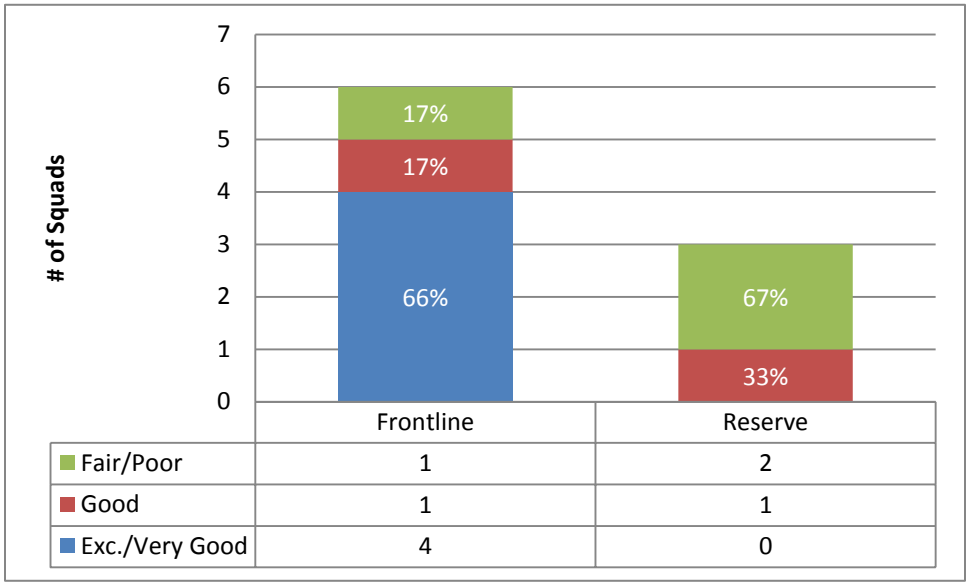
4.1.2.4 *Rescue Squads/Hazardous Materials Companies*

The FEMS fleet includes nine vehicles that are either rescue squads, hazardous materials companies, or the Critical Incident Support Unit (CISU)[16]. Six of these units are considered frontline apparatus. The average frontline squad is 7.5 years old and has logged 31,880 miles (6,581 miles/year) and 3,682 engine hours (732 engine hours/year). The average reserve squad is 12 years old and has logged 86,353 miles (6,801 miles/year) and 7,224 engine hours (601 engine hours/year).

The Project Team's qualitative assessment of squads' physical condition was that four of six frontline squads and no reserve squads were rated either in "Excellent" or "Very Good" condition (blue in the chart below), one frontline squad and one reserve squad were rated "Good" (red in the chart), and one frontline squad and two reserve squads were rated either in "Fair" or "Poor" condition (green in the chart).

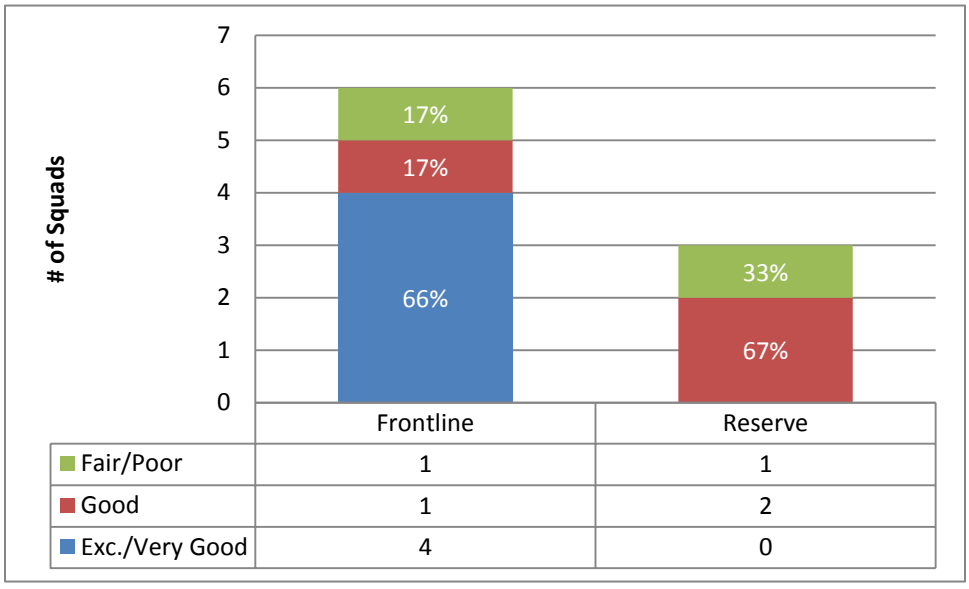
[16] These three types of units are considered together in this analysis because they are basically built on the same platform. Although they fulfill different fire service missions, the operational (i.e., driving) and maintenance characteristics are virtually the same. For simplicity sake, we will refer to this class of apparatus as "squads."

Figure 15. Physical Condition of Squads



The Project Team's qualitative assessment of squads' engine condition was that four of six frontline squads and no reserve squads were rated either in "Excellent" or "Very Good" condition (blue in the chart below), one frontline squad and two reserve squads were rated "Good" (red in the chart), and one frontline squad and one reserve squad were rated either in "Fair" or "Poor" condition (green in the chart).

Figure 16. Engine Condition of Squads



Overall, the frontline squads are in much better condition than their counterparts from the engine and truck company fleets. This is not surprising because squads run less than either engine or truck companies (although they often cover longer distances when they respond, which explains

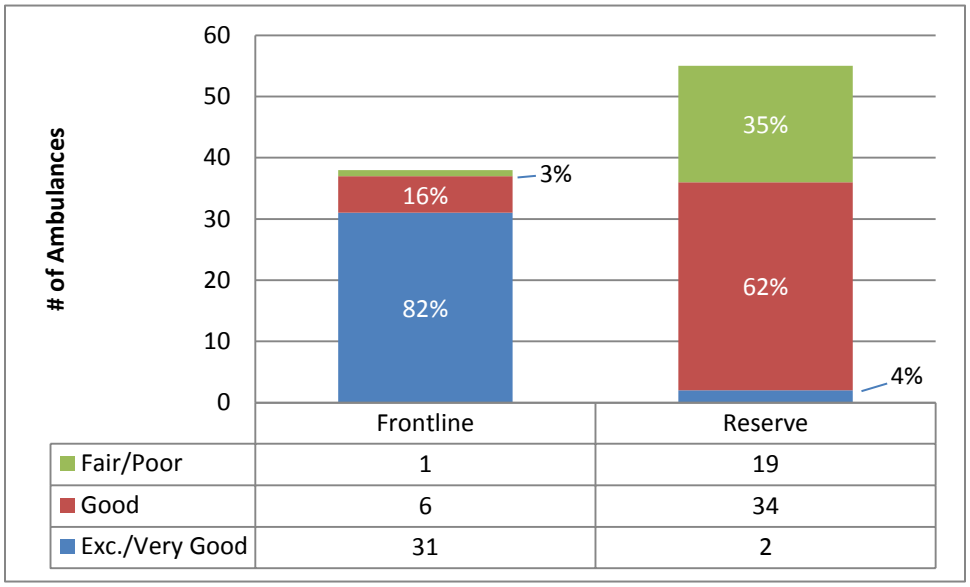
why their per-year mileage is comparable to that of truck companies). Squads, as a class of vehicles, have had comparatively few recurring work orders over the first 6 months of 2013. While four units had multiple work orders, no unit had more than four work orders in the same repair group.

4.1.2.5 *EMS Transport Vehicles*

EMS transport vehicles (ambulances[17]) comprise the majority of the FEMS fleet. There are 93 EMS units, 38 of which are considered frontline apparatus. The average frontline ambulance is 2 years old and has logged 31,472 miles (14,092 miles/year) and 3,194 engine hours (1,582 engine hours/year). The average reserve ambulance is 6 years old (range 3 to 13 years) and has logged 77,836 miles (13,387 miles/year).[18]

The Project Team's qualitative assessment of ambulances' physical condition showed that 82% of frontline ambulances and 4% of reserve ambulances were rated as either "Excellent" or "Very Good" condition (blue in the chart below), 16% of frontline ambulances and 62% of reserve ambulances were rated "Good" (red in the chart), and 3% of frontline ambulances and 35% of reserve ambulances were rated as either "Fair" or "Poor" condition (green in the chart).

Figure 17. Physical Condition of Ambulances



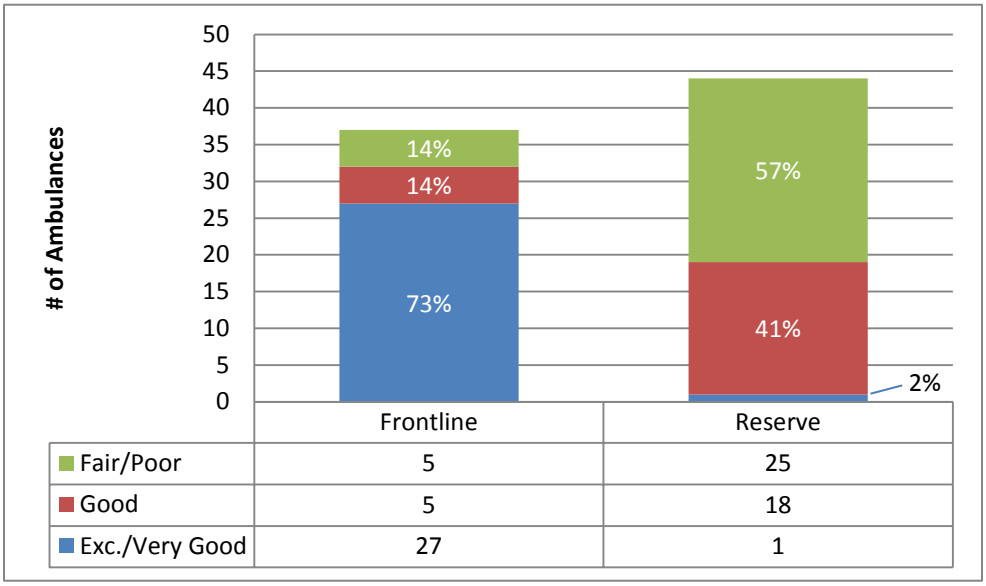
The Project Team's qualitative assessment of ambulances' engine condition showed that 73% of frontline ambulances and 2% of reserve ambulances were rated as either "Excellent" or "Very

[17] In this report the term "ambulance" means *any* EMS transport vehicle. In the National Capital Region, most fire and EMS agencies differentiate between an "ambulance" (which provides basic life support) and a "medic unit" (which provides advanced life support, or paramedic-level care); however, this distinction is not important for the analysis at hand.

[18] Most reserve ambulances in the FEMS fleet do not have engine hour meters. Hence, statistics about engine hours are omitted for this class of vehicles.

Good" condition (blue in the chart below), 14% of frontline ambulances and 41% of reserve ambulances were rated "Good" (red in the chart), and 14% frontline ambulances and 57% of reserve ambulances were rated as either "Fair" or "Poor" condition (green in the chart).

Figure 18. Engine Condition of Ambulances

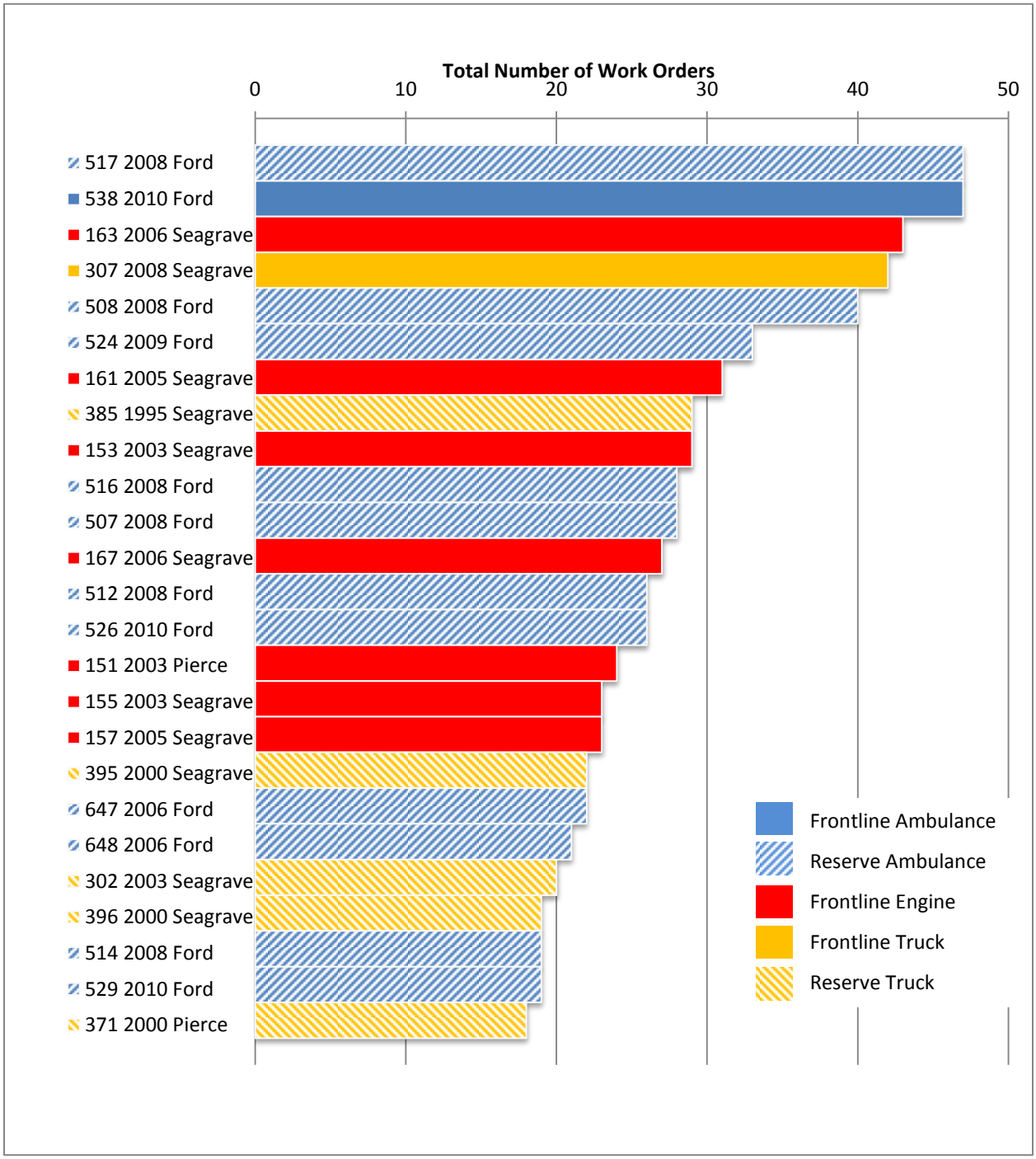


EMS transport vehicles are overworked. In many cases, EMS vehicles leave their stations first thing in the morning and do not return until late at night. They run calls and are on the road non-stop, all day long. Some in the EMS profession would call this workload "use," while others would call it "abuse." The effect of the workload on the units is undeniable. They are constantly in need of servicing. Every ambulance in the fleet had multiple work orders within a repair group submitted in the first 6 months of 2013. The highest number of work orders submitted for a single unit (a 2008 Ford) during that period was 65.

4.1.2.5.1 The Effect of the Ford Ambulances on Fleet Maintenance

There are 61 Ford ambulances in the fleet. They range in age from 3 to 9 years old, and they have logged an average of 75,015 miles. Overall, the Ford ambulances are in fairly bad shape. They break down incessantly, creating a very high volume of work for the Shop. In addition to the increased volume, the Ford ambulances create a drag on the Shop because they are significantly harder to maintain than the International Harvester ambulances. The International Harvester ambulances have a "tilt-cab" which gives mechanics easy access to the engine and other critical components. The engine housing of the Ford ambulances is the same as that of a van. The engine is considerably more difficult to access, making even standard repairs a much longer process than for the International Harvesters. For example, in order to change a fan belt in a Ford ambulance, the mechanic must take the radiator out. This makes a simple fan belt change an 8-hour job, whereas a fan belt change in an International Harvester ambulance should take approximately 1 hour.

Figure 19. Top 25 Units with Recurring Repairs (last 6 months)

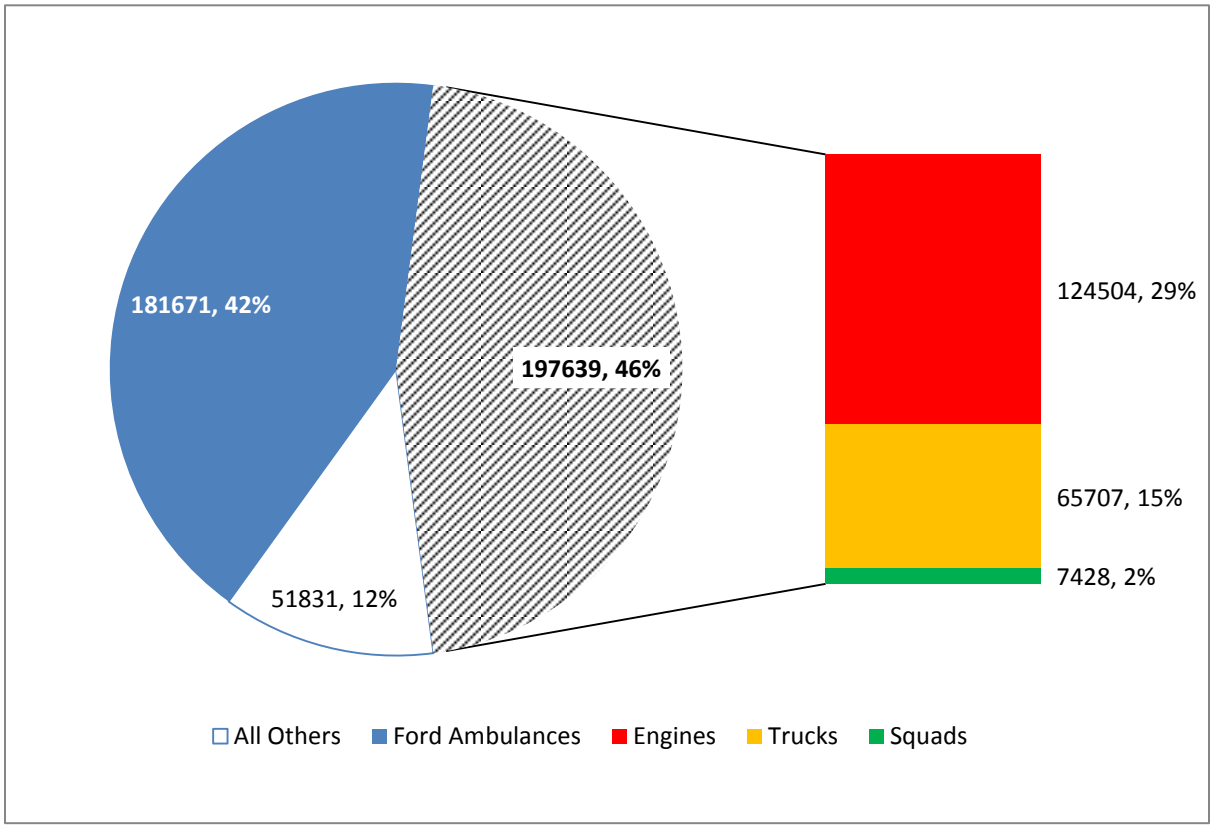


In addition to the Ford ambulances taking longer to maintain and repair than the International Harvesters, the Fords are older and have endured significantly more miles and wear-and-tear. Not surprisingly, they break down much more often than do the International Harvesters.

As Figure 19 depicts, Ford ambulances (hashed and solid blue bars) dominate in terms of recurring repairs, accounting for 12 of the top 25 units with recurring repairs in the last 6 months.

Ford ambulances accounted for 2,534 work orders in the last 12 months, or roughly 34% of the total work orders submitted for the entire fleet. In terms of work hours, these work orders resulted in a total of 181,671 hours, or 36.2%, of the work performed on the fleet. As Figure 20 clearly demonstrates, the time spent servicing the Ford ambulances alone accounts for a little less than the time for all engines, trucks, and squads/hazmat units combined (190,435 hours or 39.4% of work performed). In other words, simply by getting rid of the Ford ambulances (either through attrition or more aggressive property disposal actions), the AD could free up enough labor to conduct almost all of the repairs to the non-ambulance emergency fleet.

Figure 20. Hours Spent on Apparatus Repairs (last 12 months)



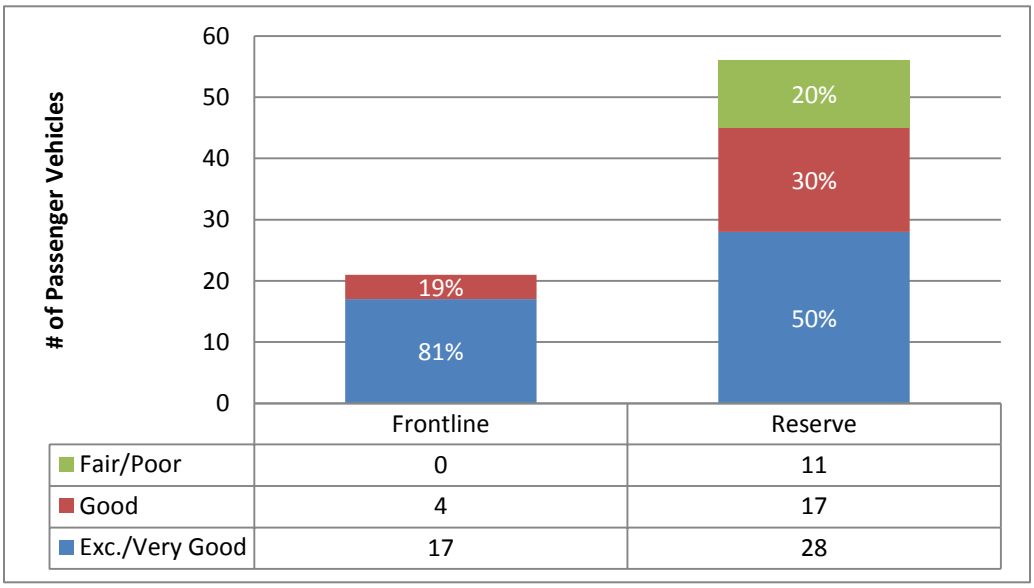
4.1.2.6 *Light Duty/Other Types of Vehicles*

The Department operates 143 vehicles that would be classified as "Light Duty" (e.g., passenger vehicles) or "Other" (e.g., trailers, forklifts, riding mowers, etc.). Some of these are self-propelled, and some are trailers. Of these 143 vehicles, only 23 would be considered frontline (i.e., vehicles with a regular emergency response role). The rest are used for administrative purposes or only rarely for emergency responses, or they are some sort of utility vehicle (e.g., a supply truck or light tower). The diverse nature of the utility vehicles makes it difficult and of

little value to attempt to present statistics on their overall condition. It is possible, however, to characterize the condition of the 81 passenger vehicles in the fleet.[19]

The Project Team's qualitative assessment of the passenger vehicles' physical condition showed that 81% of frontline passenger vehicles and 50% of reserve passenger vehicles were rated as either "Excellent" or "Very Good" condition (blue in the chart below), 19% of frontline passenger vehicles and 30% of reserve passenger vehicles were rated "Good" (red in the chart), and no frontline passenger vehicles and 20% of reserve passenger vehicles were rated as either "Fair" or "Poor" condition (green in the chart).

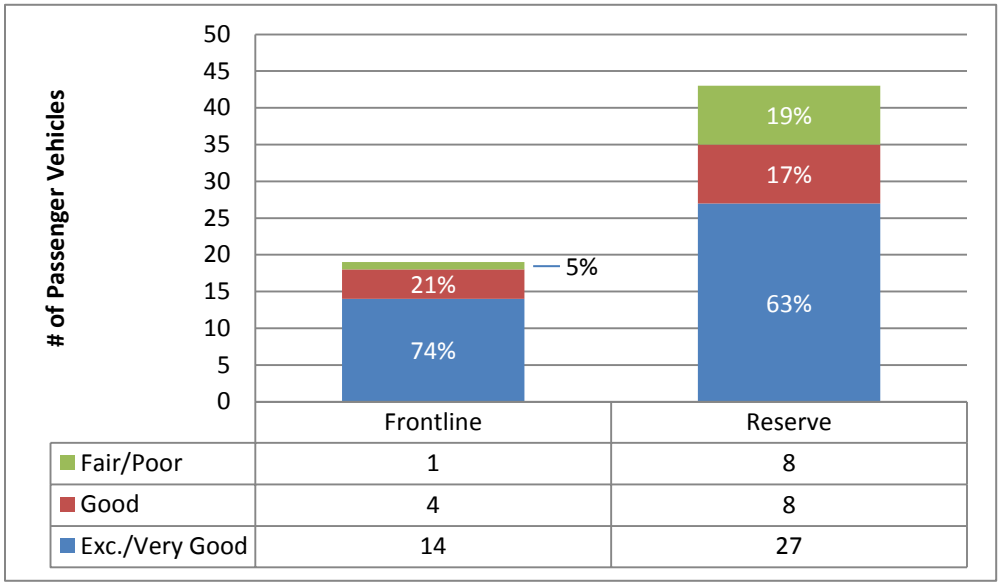
Figure 21. Physical Condition of Passenger Vehicles



The Project Team's qualitative assessment of passenger vehicles' engine condition showed that 74% of frontline passenger vehicles and 64% of reserve passenger vehicles were rated as either "Excellent" or "Very Good" condition (blue in the chart below), 21% of frontline passenger vehicles and 17% of reserve passenger vehicles were rated "Good" (red in the chart), and 5% frontline passenger vehicles and 19% of reserve passenger vehicles were rated as either "Fair" or "Poor" condition (green in the chart).

[19] The Project Team was able to inventory all but five of the passenger vehicles (because they were in use or unable to be located). Additionally, 15 passenger vehicles were locked with no key or were unable to be started. These vehicles were excluded from the qualitative assessments of physical and engine condition that follow.

Figure 22. Engine Condition of Passenger Vehicles



4.1.2.7 *Specialty Vehicles*

The FEMS fleet includes a variety of highly specialized units, including both self-powered vehicles and trailers. These units include vans and trailers with decontamination equipment, mobile command units, canteens, fireboats, collapse rescue units, rehabilitation units, Segways, foam units (including an aircraft crash truck), etc.

The extremely diverse nature of this portion of the fleet makes it difficult and of little value to attempt to present statistics on the overall condition of specialty vehicles. During the course of the physical inventory, the Project Team identified only a handful of specialty vehicles which appeared in Fair physical condition. These vehicles are listed in Table 20.

Table 20. Specialty Vehicles in Fair or Poor Physical Condition

Station #	Serial #	VIN	Unit ID	Year	Make	Condition
SOD	None	0FB5079424	Segway 2	2009	Segway	Fair
SOD	None	0FB5079425	Segway 1	2009	Segway	Fair
FB	609	1FDAF57PX3ED49804	Water Rescue Support	2003	E-One	Fair
12	720	2FZAAHAK11AJ21791	HazMat Support Unit	2001	Sterling	Fair
33	726	1BABHCOA34F217468	MCI Bus 2	2004	Bluebird	Fair
15	737	1FDWF80C4WD824438	Cave-In 3	1997	Ford	Fair
TA	759	IGTMGPL2RH543811	Mobile Command 2	1993	Int'l. Harvester	Fair
FB	803	BWCLA225K900	Fireboat 3	2000	Boston Whaler	Fair
FB	804	US-BWCLA225K0	Fireboat 3 Trailer	2000	Boston Whaler	Fair

4.1.3 Summary of Findings

28. The physical inventory revealed an aging fleet in generally unacceptable condition. While newer frontline engine and truck companies tend to be in acceptable condition, older units are only in passable[20] condition. Reserve engine and truck companies are in barely passable condition. The condition of the frontline squads is not a concern, but the reserve squad fleet is in barely passable condition.
29. Apparatus is overworked while in frontline and reserve status. Vehicles are on the road virtually non-stop. Despite a desperate need for PM and repairs, they continue to be driven as their physical and engine conditions worsen.
30. Reserve apparatus is worked as hard as frontline apparatus because so much frontline apparatus is out of service for various reasons. The reserve apparatus is badly worn by the time it becomes reserve apparatus. This, combined with the level of use of the reserve apparatus, contributes to a high failure rate and an ever-deteriorating reserve fleet.
31. The older EMS transport vehicles (i.e., the Ford ambulances) are in terrible condition. The Ford ambulances create a huge demand on the Shop for repair services and take longer to maintain and repair than the International Harvesters. By contrast, the newer EMS transport vehicles (i.e., the International Harvesters) are almost all in Excellent or Very Good shape, but this is mainly a function of their newness. If they do not receive appropriate PM, they will wind up in the same shape as the current fleet of Ford ambulances within a few years.

4.1.4 Recommendations

35. All apparatus should receive regularly scheduled PM *on time and without fail*.
36. The apparatus replacement plan should be funded and adhered to *without fail*.
37. Get rid of current Ford ambulances in order to free up Shop labor. Where the patient compartments (i.e., "ambulance boxes") are still in good condition, they should be refurbished and remounted on new chassis in order to lower costs.

4.2 Apparatus Life Cycle Costs

Life cycle costing is an economic tool which has two primary purposes:

1. Helping to make a purchase decision between two (or more) similar assets, and
2. Helping to determine the optimal point at which to replace an asset.

In the first instance, one might want to decide between purchasing a Ford pickup truck and a Chevy pickup truck. In this instance, life cycle costing would allow one to compare the total

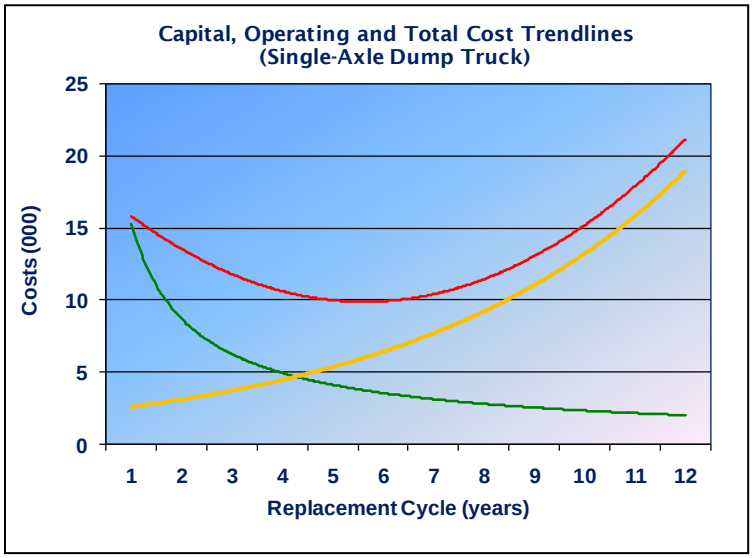
[20] By "passable" we mean that a given piece of apparatus is serviceable for its function, but its condition is far from ideal and that most fire departments would be actively attempting to replace this equipment.

cost of ownership (TCO) over the expected life of the asset. TCO includes acquisition costs, depreciation, annual expenditures on gas and PM, etc., minus any resale value. By calculating and comparing these costs, one can determine which alternative asset has the lowest TCO.

In the second instance, one would use the incremental costs associated with an asset over the life of the asset to determine the point at which the TCO begins to increase. In theory, this would be the optimal point at which to replace the asset.

Figure 23 provides a graphical explanation of how this works.[21] As a vehicle ages, its capital cost (shown as the green line) diminishes as its operating costs (shown as the yellow line) increase. The combination of these two costs produces a U-shaped TCO curve (shown as the red line). Ideally, an asset should be replaced at the age (or accumulated miles or hours of use) at which the TCO is at a minimum – that is, at the bottom of the U-shaped curve.

Figure 23. Example Total Cost of Ownership Curve



The TCO curve is different for different types of vehicles and, indeed, for individual vehicles of a given type. This variability is caused by differences in the design and engineering of different types of vehicles, operating environments, the quality of care vehicles receive, and a variety of other factors such as use in emergency operations. In recognition of this, organizations should develop *recommended* replacement cycles for particular classes or types of vehicles which reflect the optimal replacement cycle as determined from *actual cost data* on the units in that particular class. Historically, this has most often been accomplished in an informal manner based on discussions with mechanics and drivers, a comparison of replacement cycles with peer organizations, and historical replacement funding levels for an entire fleet.

[21] The discussion that follows is excerpted from a 2013 Mercury Associates/TriData report prepared for the San Antonio, TX Fire Department.

Best-practice fleet management organizations develop these cycles empirically using life cycle cost analysis techniques. This approach involves modeling the stream of costs associated with acquiring, operating, and disposing of a particular type of apparatus or piece of equipment over various replacement cycles, and then determining the cycle that will result in the lowest TCO. The equivalent annual cost (EAC) of each cycle is computed and compared in order to determine which cycle yields the minimum TCO.

The ability to do this is *entirely* dependent on being able to track the various types of costs associated with each asset accurately over the life of that asset. If the data are incorrect or incomplete, the analysis will be unreliable. **Unfortunately, as indicated in Section 3, FEMS has not collected good vehicle cost data, either in terms of labor, parts, or fuel.** This lack of quality data means it is not possible to perform life cycle cost analysis on the FEMS fleet.

4.2.1 Identification of Expected Life Cycle Costs

Life cycle costing analysis, tracking, and subsequent replacement decisions rely on data collected on the costs of purchasing, operating, and maintaining apparatus, including usage patterns and activity levels. Future life cycle costing would require examination of the age and condition of units in the fleet, total mileage and engine hours, as well as operating costs (largely fuel) and maintenance costs (including parts and labor hours).

4.2.2 Summary of Findings

32. Life cycle costing is a potentially valuable tool for FEMS to employ in making decisions about what apparatus to purchase and when apparatus should be removed from the fleet.
33. The lack of needed high-quality vehicle cost data makes it impossible to perform life cycle cost analysis on the FEMS fleet.

4.2.3 Recommendations

38. Complete and accurate vehicle cost data should be gathered and examined at least annually for each apparatus class including engines, ladder trucks/towers, heavy duty rescue, ambulances, and refurbished ambulances in order to develop and analyze a dataset to track vehicle depreciation versus operation and maintenance costs each year.

4.3 Reserve Fleet Composition

A newly configured reserve apparatus fleet should be divided into Reserve and Ready Reserve fleets. The reserve ambulance fleet should contain a third category – Special Events units, and the engine fleet should contain a third category – Water Supply units. Table 21 identifies the number of vehicles to maintain in each fleet.

Table 21. Major Apparatus by Vehicle Type and Fleet Status

	ENGINES	TRUCKS	SQUADS	AMBULANCES

Frontline	33	16	6	39
Ready Reserve	12	5	1	16
Reserve	8	5	2	11
Special Events	--	--	--	20
Water Supply	6	--	--	--
Total Needed	**59**	**26**	**9**	**86**

4.3.1 Ready Reserve Vehicles

Ready Reserve vehicles should be kept fully stocked. These are the vehicles provide for instantaneous replacement of frontline apparatus when those vehicles are called to the Shop for PM or go out of service unexpectedly or for planned short-term repairs. The vehicles in this fleet should be the best conditioned, lowest-mileage vehicles coming off of frontline duty.

Keeping a Ready Reserve fleet stocked and ready to roll reduces the need for companies to do a "change-over" to accommodate PM. Under this scenario, crews would simply drive to the Shop, park the frontline apparatus, get into the Ready Reserve, update the dispatch computer with the new unit number, and go back in service. Keeping the process this simple eliminates any disincentive for crews to bring a unit in for PM. Moreover, the community is better served by having a reliable Ready Reserve fleet because out-of-service time is minimized for any apparatus that needs to go to the Shop for repairs.

4.3.2 Special Events Ambulances

Special Events Ambulances would fill the role of the existing EMOP units. These vehicles should be maintained as ready-to-roll units. The primary function of these units is to serve at the many special events that the District hosts. When not being used for special events, these vehicles can be used to augment the frontline fleet as personnel are available; however, while they are fully stocked and ready to go, *they should NOT be used as a Ready Reserve in lieu of a reserve.* Succumbing to this temptation will ensure that these units will be worn down and unavailable for duty as Special Events Ambulances or for system augmentation when they are needed. Reserve ambulances should be changed over and used when the supply of Ready Reserves is depleted.

4.3.3 Reserve Vehicles

Reserve vehicles would not be stocked. These are the vehicles that companies would switch into for longer-term repairs. Apparatus come to the Reserve fleet from the Ready Reserve fleet, and will generally be getting towards the end of their useful life.

4.3.4 Water Supply Engines

These units should be engines that are specifically designed to handle water supply issues at major fire incidents. *Although capable of serving in a frontline capacity, they should not be deployed for any purpose but their intended use on major fires*. These vehicles are not expected

to run more than a few calls per year. To that end, older engines that are coming up on the end of their useful life are ideally suited to this function.

4.3.5 Surge Capacity

Washington, DC is a unique city and faces threats unlike most other jurisdictions. It is imperative that some apparatus is maintained in functional, ready-to-roll condition. This is true for both fire and EMS equipment. These fully stocked and ready to deploy units provide the surge capacity needed when the department goes into "Ready Alert Status," as described in Article XXV. Vehicles available for use when needed as surge capacity include the Water Supply engines, Ready Reserves that are not being used as frontline vehicles, and Special Events ambulances.

4.3.6 Reserve and Ready Reserve Fleet Needs

Keeping in mind the earlier stated assumptions regarding data collected from FASTER, unit availability was used to calculate needed reserve apparatus, as shown in Table 22.

Table 22. Reserve Apparatus Needs

	NUMBER OF FRONTLINE UNITS	NEEDED HOURS IN SERVICE (ANNUAL)	PERCENT TIME AVAILABLE	RESERVE HOURS NEEDED	RESERVES NEEDED
Engines	33	289,080	63%	106,960	12
Trucks	16	140,160	72%	39,245	5
Ambulances	54	473,040	70%	141,912	16

The number of units needed in reserve, as shown above, does not allow for the many times when frontline and Ready Reserve vehicles are unavailable simultaneously. To that end, a Reserve fleet of approximately 50% of the Ready Reserve fleet size is needed.

As was previously stated, the Ready Reserve fleet needs to be in place to facilitate an effective PM program.

4.3.6.1 *Engines*

Currently, the engine fleet has 32 vehicles rated as "Excellent," "Very Good," or "Good," with six new vehicles on order. The recommended Replacement Schedule calls for seven more engines to be ordered in FY15, which (with proper PM of the existing fleet) could allow for 45 "Good" or better pumpers in short order – 33 frontline and 12 for the Ready Reserve fleet.

4.3.6.2 *Trucks*

The ladder truck fleet currently has 13 frontline units with a physical condition that is "Excellent," "Very Good," or "Good," with one reserve also rating "Good." All of the frontline ladder trucks have engine conditions of "Good" or better. There are two new trucks on order,

and the replacement schedule calls for three more, beginning in FY15, bringing the frontline and Ready Reserve fleets up to "Good" or better engine conditions. The Reserve fleet of ladder trucks should consist of five vehicles. While the Reserve fleet for other apparatus types is maintained at 50% of the Ready Reserve fleet, the truck Reserve fleet should be 100% of the Ready Reserves. Repairs to complex aerial devices can be very time consuming, and a Reserve fleet of only two or three vehicles could lead to shortages of truck companies available to place in service. Therefore, a Reserve fleet of five truck companies is recommended.

4.3.6.3 *Ambulances*

The frontline ambulance fleet consists of 39 vehicles. In addition to the normal EMS call volume, the nature of Washington, DC requires that ambulances are available for protests, marches, political events, sporting events, and countless other situations. To that end, department officials dealing with these special events have expressed a need for 20 Special Event ambulances. These units, similar to the current EMOP units, should be kept fully stocked and ready for immediate deployment. Table 22 shows that 16 Ready Reserve ambulances are needed, and 11 unequipped reserves should be maintained.

This brings the total ambulance fleet to 86 vehicles – seven fewer than are currently in the fleet. It is important to remember that a proper PM program will reduce the number of ambulances that are out of service for long-term repairs. Also, the increased acquisition of moderate-duty ambulances (e.g., the International Harvester ambulances) rather than the Ford ambulances will result in a more reliable fleet.

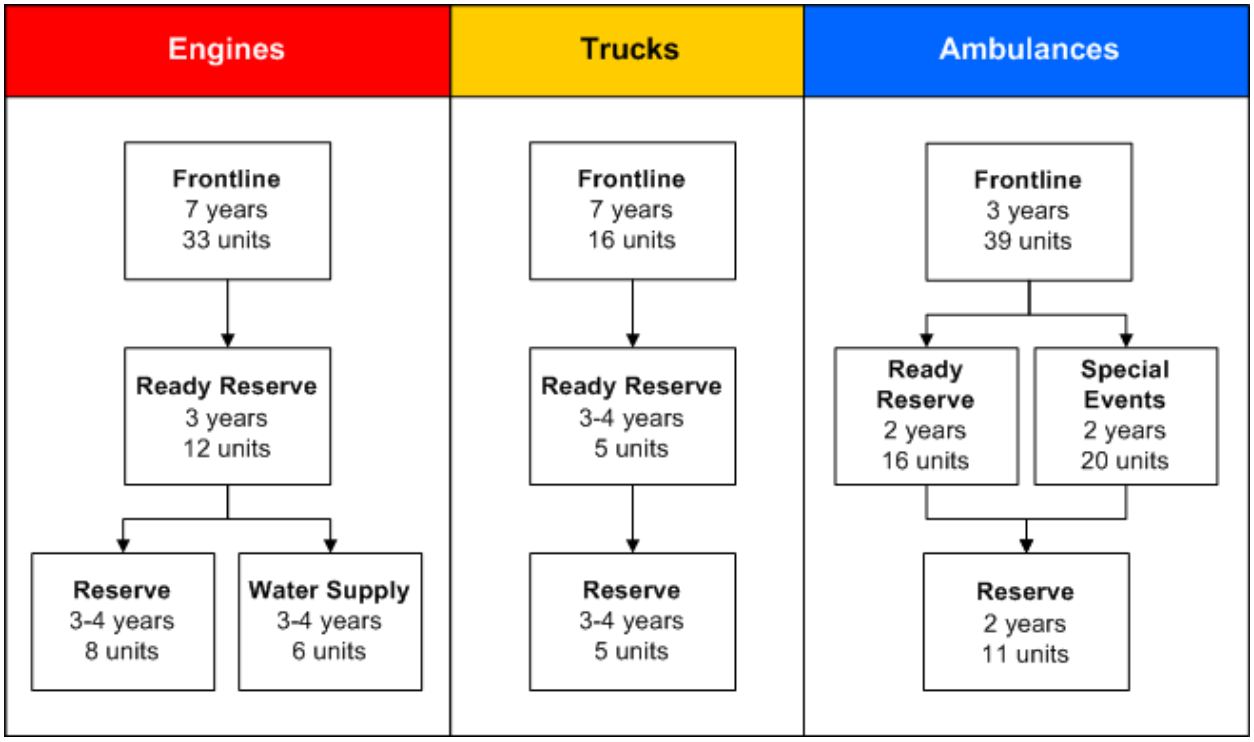
4.3.6.4 *Squads*

The fleet of squads (i.e., Rescues Squads, Hazardous Materials Units, and the CISU) consists of specialized heavy-duty units. Currently, one Reserve Rescue Squad is maintained in a stocked and ready-to-roll (i.e., Ready Reserve) capacity. In addition to this unit, there are two regular reserve squads (i.e., not stocked with equipment). We feel that this is sufficient reserve capacity for this grouping of units. The unique mission and expense of these vehicles, as well as the small size of the frontline component of the squad fleet, argues against the algorithmic approach applied for calculating the required number of reserve engines, trucks, and ambulances.

4.3.6.5 *Service-Life Progression*

This plan sets forth a map for transitioning a vehicle through the full spectrum of its service life from Frontline status through Ready Reserve (or Special Events) and into Reserve status. Vehicles at the older end of the Reserve spectrum would be removed from the fleet through a Property Disposal Action. The expected service-life progression, with target ages for transitioning from one sub-fleet to the next, is shown in Figure 24.

Figure 24. Service Life Progression



The progression for squads should follow a similar pattern to that of truck companies, but the unique nature of their functions and how they are equipped requires a more individualized approach. Squads should run in a frontline capacity for 7 years, followed by 3 to 4 years in a Ready Reserve capacity, and then another 3 to 4 years as an unstocked reserve vehicle.

4.3.7 Historical Analysis of Purchasing

FEMS provided the Project Team with data detailing heavy frontline equipment purchases over the last 14 years for engines, trucks, and squads from 2000 to 2013, and for ambulances and SUV purchases for 7 years from 2006 to 2012.

As Figure 25 to Figure 29 starkly depict, there has been considerable unevenness in apparatus replacement since 2000. In these figures, the red line shows the number of planned procurements for each type of apparatus, and the blue bars show the number of units actually procured each year. The peaks and the valleys in procurement activity are self-evident.

4.3.7.1 *Historical Analysis of Engine, Truck and Squad Purchases*

Analysis of data provided shows clearly that, while FEMS had scheduled to purchase a given number of engines, trucks, and squads per year, the AD has not been successful in applying scheduled replacements.

Figure 25 and Figure 26 show major discrepancies in the first year of the replacement plans both for engines and for trucks, where six scheduled replacements were expected versus 15 purchases made for new engines, and where two scheduled replacements were expected versus five purchases made for new trucks. This is more than double the scheduled purchases for the year 2000 alone for both engines and trucks. The graph suggests the AD was required to freeze purchasing the following year for engines and trucks, launching the beginning of a cyclical imbalance in service-life progression that has persisted into 2013.

Consequently, actual purchases for engines and trucks pose a greater financial burden, on average, 2 out of every 3 years. Scheduled purchases for engines and trucks should be made every year in order to avoid unnecessary burden (including financial and maintenance), to ensure vehicle service-life transitioning is staggered and the fleet composition is well-rounded.

This purchase history has meant that FEMS' procurement is behind schedule on the purchasing of 10 engines and three trucks over 14 years.

Figure 25. Engine Purchases by Year (2000 to 2013)

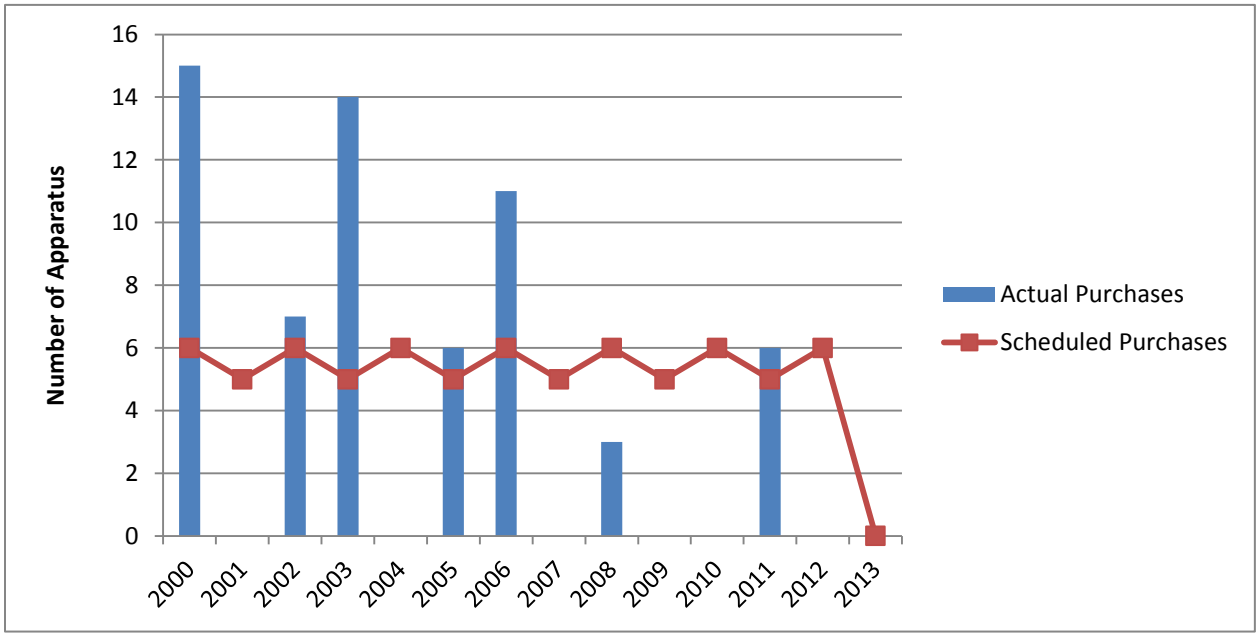
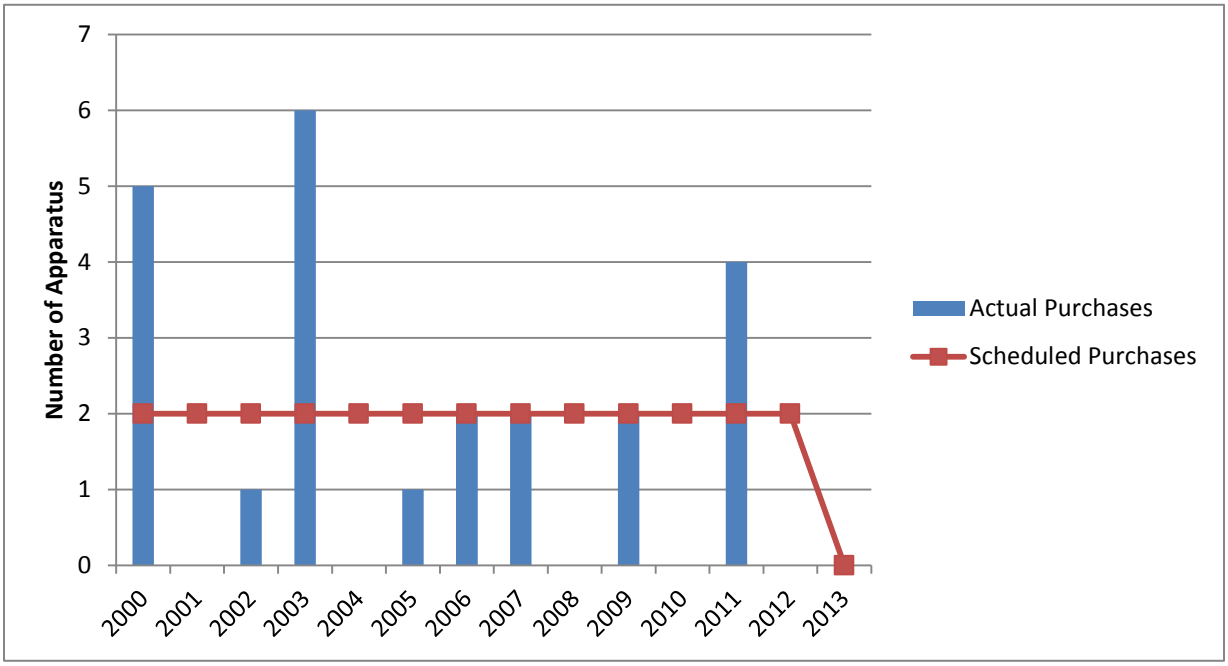


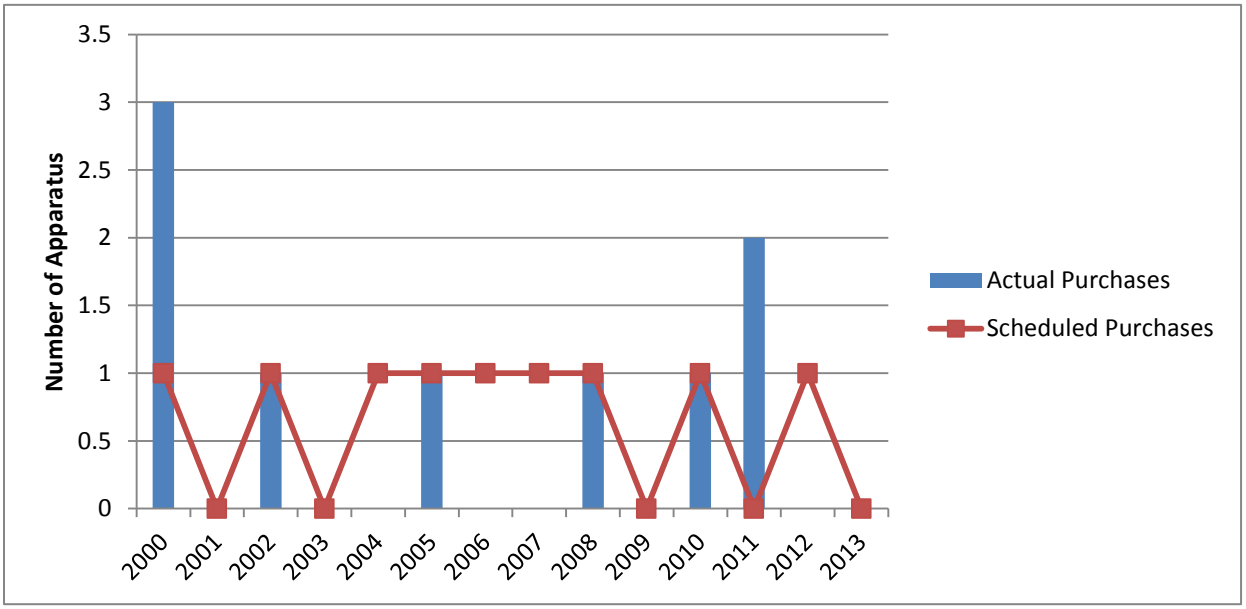
Figure 26. Truck Purchases by Year (2000 to 2013)



Patterns in squad purchasing over the past 14 years have been less erratic than purchases for engines and trucks, albeit off-schedule. Triple the number of squads purchased in 2000 seemed to affect purchasing patterns through the next several years where scheduled purchases were missed in 2004, 2006, and 2007.

This purchase history has meant that FEMS' procurement is behind schedule on the purchasing of two squads over 14 years.

Figure 27. Squad Purchases by Year (2000 to 2013)

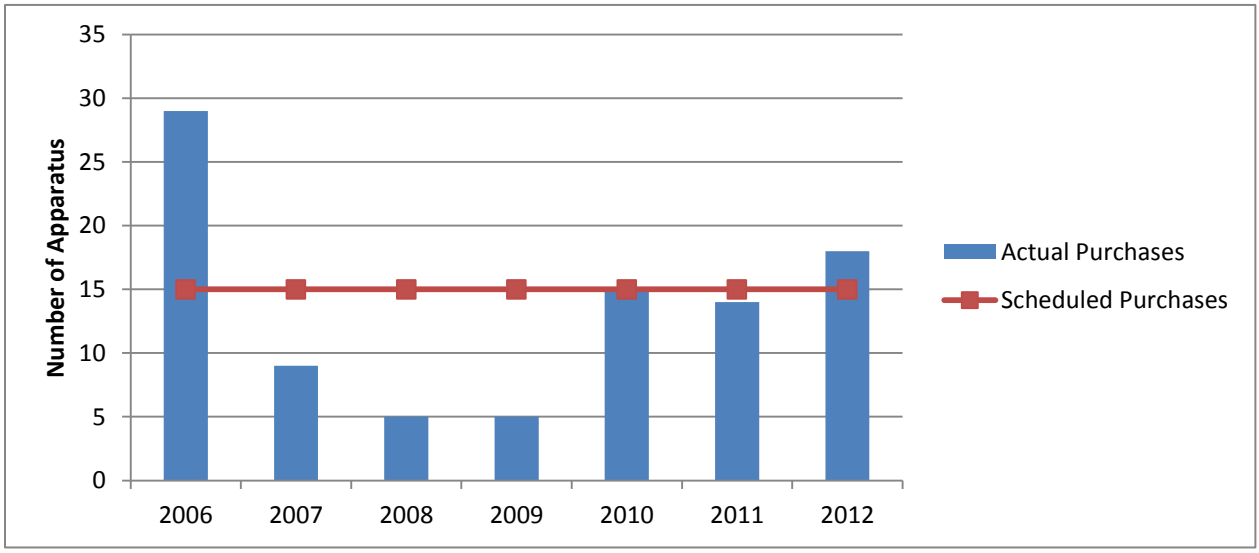


4.3.7.2 *Historical Analysis of Ambulances and SUV Purchases*

Frontline ambulances should be no more than 3 years old. In order to maintain this service level, it is imperative that actual purchases match scheduled purchases, which, as evident in Figure 28, has not been the case in purchasing patterns over the past 7 years with FEMS. Major purchasing of 29 ambulances is evident in 2006 while a downward trend through 2009 shows only 19 new ambulances were purchased over 3 years versus the scheduled 45. From 2010 to 2012, FEMS has maintained more consistent purchasing patterns setting an example for improvement in subsequent years.

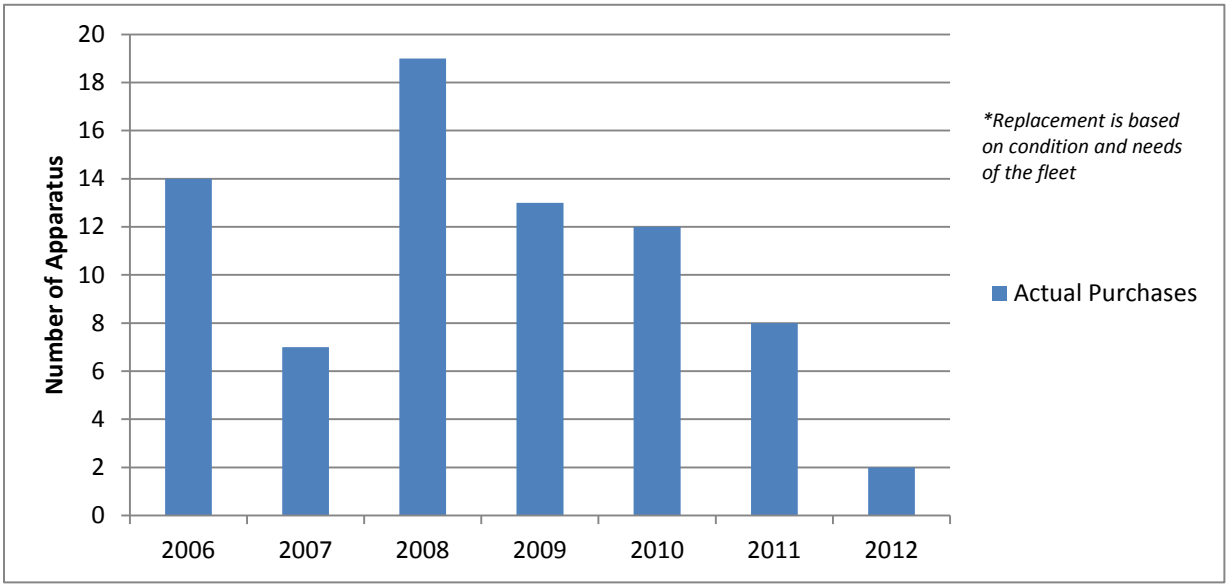
This purchase history has meant that FEMS' procurement is behind schedule on the purchasing of 15 ambulances over 7 years.

Figure 28. Ambulance Purchases by Year (2006 to 2012)



SUV replacement purchases are based on the condition and needs of the fleet. Figure 29 shows the height of SUV purchasing to have been in 2008 with a steady decline in purchasing since. With an average replacement age of 7 years, it is likely that FEMS will need to replace some or many of the SUVs purchased in 2008 nearing 2015. Projected purchases from 2013 can be expected to increase for this reason.

Figure 29. SUV Purchases by Year (2006 to 2012)



Fitful buying of costly apparatus creates extreme burdens on the fleet and on the AD which must maintain the fleet. When large numbers of apparatus are procured at the same time, it is much more likely that that apparatus will later fail at the same time. This means that apparatus moving into the reserve fleet is in worse shape than it otherwise would be and that the AD will have a harder time maintaining the older units in both the frontline and the reserve fleets. Furthermore, the AD must ready new apparatus for service and decommission apparatus subject to a property disposal action. This means there is a much greater workload for the AD in high procurement years because it must work the new (and old) apparatus into the already-busy Shop schedule.

Additionally, it is much easier to budget for apparatus replacement when procurement is done on a regular basis. This is because it is easier to cut sporadic large capital budget requests than to cut consistent smaller ones.

4.3.8 Summary of Findings

34. The condition of the reserve fleet is inadequate to support a heavily used frontline fleet.
35. Keeping a Ready Reserve fleet stocked and ready to roll reduces the need for companies to do a "change-over" to accommodate PM.
36. Annual procurement of all types of FEMS apparatus has been extremely uneven since at least year 2000.
37. FEMS is behind schedule on the purchasing of 10 engines, three trucks, and two squads over the last 14 years. FEMS is also behind schedule on the purchasing of seven ambulances over the last 7 years.

38. Peaks and valleys in fleet replenishment create problems in terms of apparatus condition and demands on the Shop for maintaining and repairing existing apparatus as well as placing new apparatus in service and retiring old apparatus.
39. Uneven procurement stresses the FEMS capital budget, making it more difficult to do long-term financial planning and subjecting larger capital budget request to trimming.

4.3.9 Recommendations

39. Configure reserve apparatus fleet by reserve and ready reserve fleets. A reserve fleet of approximately 50% of the ready reserve fleet size is recommended because of the heavy usage and frequent failures of frontline vehicles.
40. Ready Reserve vehicles should be fully stocked, in top condition, with lowest mileage coming off of frontline duty.
41. Reserve ambulance fleet should include a Special Events Unit, which should be maintained as ready-to-roll units.
42. Engine fleet should include a Water Supply Unit, specifically designed to handle water supply issues at major fire incidents.
43. Finalize and adhere to an apparatus replacement schedule (see Section 2) to ensure a continual flow of units through frontline, ready reserve, and reserve status.
44. Work to educate the D.C. Council and the Office of the Chief Financial Officer about the need to adhere to a strict procurement schedule so that short-term cost savings are not obtained at the expense of long-term problems in the fleet.

4.4 Recommended Replacement Schedule

The fleet is not in a good position. Due to a host of previously mentioned factors, the frontline fleet is tired, and the reserve fleet is not in good condition. To that end, a phased replacement schedule is being put forth. Initially the replacement schedule is very aggressive and designed to bring the fleet back into a better position. From that point a more relaxed schedule can be put into place to maintain the fleet once it has been restored to a healthy condition.

The replacement schedule is based on the following assumptions:

- Frontline engines should be no more than 7 years old
- Frontline trucks should be no more than 7 years old
- Frontline ambulances should be no more than 3 years old
- Frontline squads should be no more than 7 years old
- An effective PM program that will allow for 90% of each unit type to serve in a reserve capacity for the same amount of time spent running as a frontline unit.

Initially, engine and truck companies should be replaced on an accelerated basis. Engines should be replaced on a 5-year frontline cycle and trucks on a 5.3-year frontline cycle. This will bolster the health of the frontline fleet and allow older currently owned pieces of apparatus to trickle down into reserve service more quickly, thus strengthening the overall condition of the reserve fleet. Squads do not need an accelerated replacement schedule because the reserve fleet is fairly sound condition. The ambulance fleet, bolstered by the recent addition of 24 new and six refurbished units, can also move straight into a long-term replacement plan. Due to their low call volumes, specialty vehicles[22] have no specific need for a set replacement schedule in the short term. They are generally highly specialized units that should be monitored closely to ensure that FEMS has sufficient lead time to replace these units as needed.

Once this replacement schedule has been implemented, it must be adhered to – in good financial years and in bad. Going for a long period of time without bringing new vehicles into the fleet and then making a massive purchase is one of the reasons the fleet is in the less-than-optimal condition that it now is. Skipping, or even scaling back for one year, creates a ripple that is felt for what would have been the life of that vehicle.

4.4.1 Replacement by Apparatus Type

4.4.1.1 *Engine Replacement*

The frontline fleet should consist of 33 engines. Initially based on a 5-year frontline cycle, engine replacement schedule should be 33÷5, or 6.6 per year (seven engines purchased each year for two years followed by six engines in the third year). After 5 years the schedule should move to a 7-year frontline life cycle, or 4.7 per year (five engines each year for the first three years, and four in the fourth year). The more aggressive initial schedule is necessary to aid in the development of a proper Ready Reserve fleet as a proper PM program is established.

4.4.1.2 *Truck Replacement*

The truck fleet also requires an accelerated replacement cycle in order to rebuild the fleet. An initial frontline life of 5.3 years calls for three trucks per year for five years. This would be followed by a more relaxed schedule of 7 years of frontline service that calls for three trucks purchased one year, then two the next year, followed by two more the year after that.

4.4.1.3 *Squad Replacement*

Squads should be on a 7-year frontline cycle, which can be accomplished by purchasing one per year for each of 6 years, followed by a year in which no squads are purchased.

[22] Specialty vehicles are low-call-volume units which fill a limited and specialized mission for FEMS. They include air units, shop vehicles, field command units, foam units, boats, mass casualty units, buses, logistics vehicles, forklifts, brush units, etc.

4.4.1.4 *Ambulance Replacement*

Frontline ambulances should be no more than 3 years old, and Special Events ambulances should be no more than 5 years old. This yields a weighted average of service life of approximately 3.7 years. To have 39 frontline units plus 20 Special Events units (a total of 59 units) with a service life of 3.7 years means that 16 ambulances should be purchased annually. The recent addition of 30 ambulances allows the replacement cycle to start, and remain constant, at 16 units per year.

The AD should evaluate ambulances each year to determine which "boxes" (i.e., the patient compartment) can be remounted on new chassis (i.e., which ambulances can be refurbished). Refurbishment of salvageable boxes permits acquisition of a "new" unit for substantially less than the cost of a brand new unit.

4.4.1.5 *Command Vehicle Replacement*

The fleet contains 31 sport utility vehicles that serve primarily as command vehicles. Others serve as K9 transport vehicles, take-home vehicles for senior staff, and utility vehicles. Of these 31 vehicles, 18 are in regular frontline usage.[23] Others should be considered reserve units. Vehicles for staff positions that do not regularly respond to emergencies should come from the reserve fleet or the fleet of GSA-leased vehicles.

Data in FASTER indicate that these 18 units were unavailable for a combined 10,484 hours from July 1, 2012 through June 30, 2013. Three units listed as reserves – serial numbers 216, 218, and 241 – were *available* for more than 25,000 hours, which is more than sufficient to cover the needed down time in the frontline units. The fleet also has several other older reserve vehicles (all Fords) that are at least 10 years old.

In order to accommodate a fleet of frontline command vehicles of less than 6 years of age, the departments needs to purchase an average of three vehicles per year. In order to continue to provide similar vehicles to other non-essential personnel, then the Department should purchase five vehicles annually.

4.4.2 Annual Purchases

The number of units to purchase annually is identified in Table 23.

Table 23. Units to Purchase (by year)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Engines	7	7	6	7	7	5	5	5	4	5	5	5
Trucks	3	3	3	3	3	2	2	3	2	2	3	2
Squads	1	1	1	1	1	1	0	1	1	1	1	1

[23] In this context, we define "regular frontline usage" to mean that the vehicle is dispatched to incidents on a daily basis. This does not include some vehicles that are frontline, but which are not staffed and dispatched to incidents as the normal course of the day of their operators.

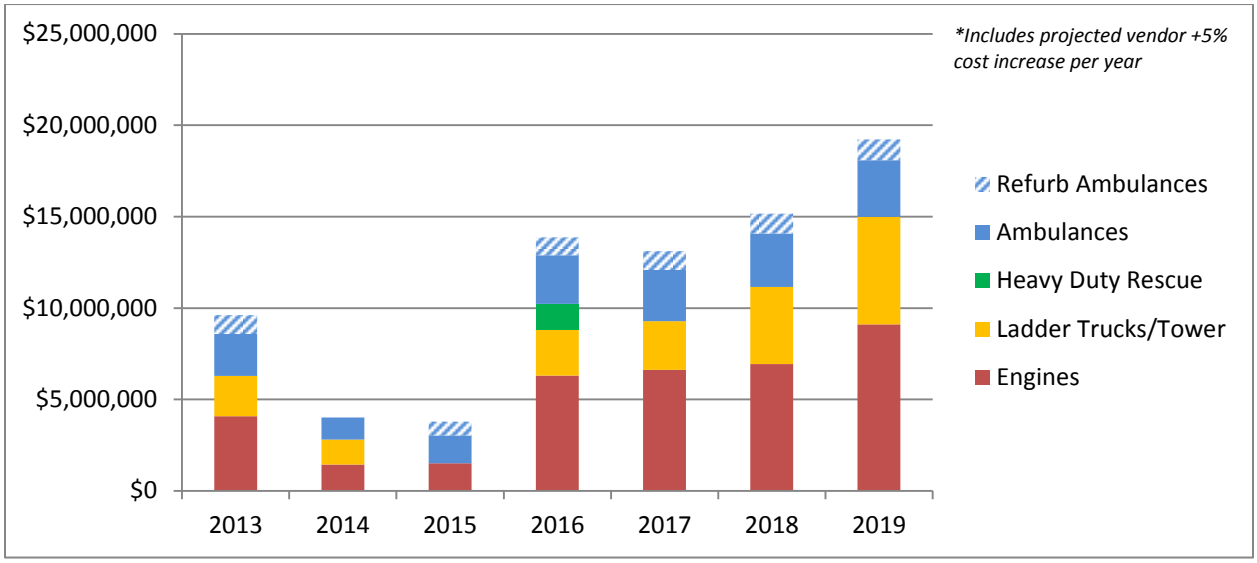
	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Ambulances	16	16	16	16	16	16	16	16	16	16	16	16
Command	5	5	5	5	5	5	5	5	5	5	5	5

This system offers a very clear budget forecast. Projecting annual increases of 5%, unit costs can be budgeted as shown in Table 24.

Table 24. Estimated Unit Procurement Cost

	FY15	FY16	FY17	FY18	FY19
Engines	$ 749,700	$ 787,185	$ 826,544	$ 867,871	$ 911,265
Trucks	$1,212,750	$1,273,388	$1,337,057	$1,403,910	$1,474,105
Squads	$1,257,143	$1,320,000	$1,386,000	$1,455,300	$1,528,065
Ambulances	$ 253,575	$ 266,254	$ 279,566	$ 293,545	$ 308,222
Command	$ 105,000	$ 110,250	$ 115,763	$ 121,551	$ 127,628

Figure 30. Total Cost of Apparatus Purchases by Year



A benefit to this system is that it brings the fleet back into good condition over time, rather than demanding a significant influx of funding up front. The situation with the fleet cannot be fixed completely overnight. A well-timed, balanced approach carried out over a long period of time will stabilize the fleet's maintenance requirements and will do so without breaking the bank.

When a unit has suffered catastrophic damage, it must be replaced as soon as possible. Using a reserve in its place for any length of time adds to the maintenance backlog that has swamped the Shop and prevented the implementation of a proper PM program.

Annual budget requirements are shown in Table 25.

Table 25. Estimated Annual Budget for Apparatus Replacement

	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
Engines	$ 5,247,900	$ 5,510,295	$ 4,959,266	$ 6,075,100	$ 6,378,855	$ 4,784,141
Aerials	$ 3,638,250	$ 3,820,163	$ 4,011,171	$ 4,211,729	$ 4,422,316	$ 3,095,621
Rescues	$ 1,257,143	$ 1,320,000	$ 1,386,000	$ 1,455,300	$ 1,528,065	$ 1,604,468
Ambulances	$ 4,057,200	$ 4,260,060	$ 4,473,063	$ 4,696,716	$ 4,931,552	$ 5,178,130
Command	$ 525,000	$ 551,250	$ 578,813	$ 607,753	$ 638,141	$ 670,048
Total	**$14,725,493**	**$15,461,768**	**$15,408,312**	**$17,046,599**	**$17,898,929**	**$15,332,408**
	FY 21	**FY 22**	**FY 23**	**FY 24**	**FY 25**	**FY 26**
Engines	$ 5,023,349	$ 5,274,516	$ 4,430,593	$ 5,815,154	$ 6,105,912	$ 6,411,207
Aerials	$ 3,250,402	$ 5,119,383	$ 3,583,568	$ 3,762,747	$ 5,926,326	$ 4,148,428
Rescues	$ -	$ 1,768,926	$ 1,857,373	$ 1,950,241	$ 2,047,753	$ 2,150,141
Ambulances	$ 5,437,036	$ 5,708,888	$ 5,994,332	$ 6,294,049	$ 6,608,751	$ 6,939,189
Command	$ 703,550	$ 738,728	$ 775,664	$ 814,447	$ 855,170	$ 897,928
Total	**$14,414,337**	**$18,610,441**	**$16,641,531**	**$18,636,638**	**$21,543,912**	**$20,546,893**

This replacement schedule is very specific. Many factors may result in the need to modify the plan, particularly further out. This schedule should be reviewed regularly and modified as needed. It is imperative, however, that the fleet be updated annually. Delays in apparatus purchases create a snowball effect in the fleet, and delaying purchases to a later year, when prices will be higher, is expensive. Using the same prices and the same number of units to be purchased, but making major purchases every 3 years instead of spreading them out, is more than $10 million more expensive.

Table 26. Effects of Delaying Purchases

	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
Engines	$ -	$ -	$16,530,885	$ -	$ -	$18,179,737
Aerials	$ -	$ -	$12,033,512	$ -	$ -	$12,382,484
Rescues	$ -	$ -	$ 4,158,000	$ -	$ -	$ 4,813,405
Ambulances	$ -	$ -	$13,419,189	$ -	$ -	$15,534,389
Command	$ -	$ -	$ 1,736,438	$ -	$ -	$ 2,010,143
Total	**$ -**	**$ -**	**$47,878,024**	**$ -**	**$ -**	**$52,920,158**
	FY 21	**FY 22**	**FY 23**	**FY 24**	**FY 25**	**FY 26**
Engines	$ -	$ -	$15,507,077	$ -	$ -	$19,233,621
Aerials	$ -	$ -	$12,542,489	$ -	$ -	$14,519,498
Rescues	$ -	$ -	$ 3,714,745	$ -	$ -	$ 6,450,423
Ambulances	$ -	$ -	$17,982,997	$ -	$ -	$20,817,567
Command	$ -	$ -	$ 2,326,992	$ -	$ -	$ 2,693,784
Total	**$ -**	**$ -**	**$52,074,300**	**$ -**	**$ -**	**$63,714,894**

4.4.3 Rotation of Apparatus between High- and Low-Volume Stations

The Boston Fire Department (BFD), one of the agencies used for comparison in this report (see Section 5.1.1), is in the process of rebuilding its fleet from conditions and past practices quite similar to those facing FEMS' current fleet. One component of the BFD initiative to improve its

fleet operations is to take frontline apparatus from busy stations, refurbish it, and assign it to slower stations. We considered this concept for FEMS, as it has some appeal. Wear and tear is spread more evenly across the fleet, and a well-maintained unit that was refurbished at five years of age is, in theory, capable of serving at least another 10 years at a slower station.

There are several drawbacks to this system. First, pride of ownership is reduced. Drivers at busier stations would know that, after a few years, they would be getting another new rig and that their "old" unit would become somebody else's problem. Also, the drivers at slower companies would constantly be getting somebody else's hand-me-downs, which is a sure way to undermine morale.

Secondly, the Ready Reserve fleet will benefit greatly from vehicles that had seen five relatively slow years at less busy stations as they will make *great* Ready Reserve vehicles.

Finally, there is a trend towards shorter life cycles for fire apparatus. The NFPA addresses this in several standards, including NFPA 1901 (Standard for Automotive Fire Apparatus). Rapidly advancing vehicle technology makes apparatus outdated sooner than was the case 20 years ago. According to this standard, "In the last 10 to 15 years, much progress has been made in upgrading functional capabilities and improving the safety features of fire apparatus."

Additionally, a recent legal case in the City of New York provides some precedent on the issue. A State Supreme Court is prohibiting the use of any fire apparatus that is more than 10 years old. While this does not have any direct impact on fire apparatus usage in Washington, DC, it does go to show the trend towards maintaining "younger" fleets.

There is no reason to expect a change to this trend. Accordingly, providing a replacement plan that calls for engines to potentially remain in frontline service for as many as 15 years, even with a refurbishment, is not in FEMS' best interest. Granted, the plan we describe does call for vehicles to remain in the fleet for 14 years, but much of this time is in a reserve capacity (i.e., a lower call volume). In a perfect world this would not be the case. In this very real world, however, it is very difficult to recommend replacing million-dollar ladder trucks based simply on the year they were built.

4.4.4 Summary of Findings

40. There is a trend in the fire service toward maintaining a younger fleet.
41. A replacement plan that calls for engines to remain in frontline service for 15 years or more is not in FEMS' best interest.
42. Deferred replacement of apparatus places unnecessary strain on fleet operations and fleet maintenance requirements.

4.4.5 Recommendations

45. New apparatus should be budgeted for and procured on a consistent, on-going basis. Replacement of apparatus should not be deferred because of the strain that such actions place on the fleet.
46. Apparatus that is unexpectedly lost in a catastrophic event (e.g., crash or fire) should be replaced on an expedited basis. The reserve fleet should be used as little as possible to backfill apparatus lost in these circumstances.
47. Apparatus should not be rotated from high-volume to low-volume stations.
48. Adhere to the replacement schedule outlined in Section 4.4.2.

SECTION 5. APPARATUS DIVISION OPERATIONS

This section provides an in-depth analysis of the operations of the Apparatus Division and makes recommendations for improvement.

5.1 Overview

The FEMS fleet is currently in a critical state, with chronic long-term management, maintenance, and replacement issues. FEMS apparatus routinely break down, forcing the AD to spend literally almost of its time working on "critical" repairs rather than preventative maintenance. Because these issues have been endemic over many years, keeping the FEMS fleet running is a momentous task. To break this cycle would require a major strategic intervention and investments in infrastructure, codifying effective policies and procedures, and allocating personnel and technical resources appropriately to effectuate change.

While addressing the problems in the AD falls to the current administration, they are not of its creation – the problems are systemic in nature and the result of budget cutting and organizational neglect that has occurred over a span of 15 to 20 years (at a minimum). There is no one single overriding problem in the AD. Rather, severe problems exist in all facets of the AD:

- Management Information Systems (discussed in Section 3)
- People
- Processes
- Physical Infrastructure
- Policies and Procedures
- Procurement

Exacerbating the problems at the AD is the excessive wear-and-tear on the FEMS fleet caused by the extraordinarily high call volume – especially of EMS calls.

Rectifying the situation at AD will require a plan to strategically roll out new fleet management, maintenance, and replacement approaches, and would require investments in infrastructure, policies and procedures, and training. This will be most effective if done in phases and will take time, effort, and would likely require special funding. Even if it were possible simply to purchase an entirely new fleet in one year (which would alleviate only some of the problems with which the AD must contend), however, it would be unwise to do so, for doing so would necessitate the wholesale replacement of the FEMS fleet when the new apparatus reaches the end of its useful life. Rather, fleet replacement should commence as soon as possible but in a phased manner so that the replacement burden is spread out as evenly as possible and so that as

apparatus reaches the end of its useful life, it is retired and replaced by equal numbers (and types) of new apparatus.

To ensure that high quality and reliable fire and EMS services are continuously delivered in the District of Columbia as a long term strategic objective, would require the support of the administration and would necessitate significant short-, medium-, and long-term investments. This is an expensive proposition that would require D.C. Council buy-in since it would likely involve millions of dollars spread over the next seven to 10 years. It is our position that the situation is at such a critical juncture that serious consideration should be given to taking immediate action.

5.1.1 Comparative Analysis

To put the AD in perspective, it can be helpful to compare the Department with other organizations that share similar characteristics. In doing so, Department and District leaders can identify benchmarks that can be used to assess their own performance and practices. When these comparisons are drastically different, further evaluation is required. When they are similar they can provide a valuable mirror from which to demonstrate practices are on the right track.

The Project Team conducted a comparative analysis of the fleet maintenance programs of the fire departments of five cities: Baltimore, Boston, Philadelphia, Oakland, and Seattle. The team judged these cities to be good points of comparison because of their highly urbanized nature and rough equivalencies in population, area, and density.[24]

Jurisdictional comparisons can be difficult to interpret as there are many variables. No two jurisdictions are exactly alike in terms of geographic size and features, population dynamics, or governmental organization, services provided and how department organizational needs are addressed and administrated. Many jurisdictions do, however, share some similar qualities that are useful for comparison. While these comparisons are not direct indicators of departmental performance, they do provide a valuable function in assessing a department in relation to the performance of its peers. This direct comparison identifies organizational strengths (and weaknesses) and suggests areas for improvement.

The jurisdictions chosen for comparison all possess characteristics similar to Washington, DC. The data were obtained from websites and direct contact with the departments, from a prepared questionnaire specifically designed to address the ideas identified in the fleet management audit. For example, population estimates may differ by thousands of residents. In this type of comparison, such variances are usually insignificant.

[24] It must be noted that due to DC's small geographic area, finding close matches for all three factors is very difficult. DC is fairly similar in area to Boston, Seattle, and Baltimore. DC has almost the same nighttime population as these three cities. DC's huge daytime populations influx, however, are considered, DC is much more like Philadelphia in size, and DC's population density is almost exactly the same as Boston's.

5.1.1.1 *Stations and Equipment*

The following tables depict comparative data from the five comparison jurisdictions and Washington, DC.

Table 27. Comparison of Population Served per Station

JURISDICTION	POPULATION	AREA SERVED (SQ. MI.)	POPULATION DENSITY	NUMBER OF STATIONS	SQUARE MILES PER STATION
Boston, MA	636,479	48	12,900	35	1.4
Oakland, CA	390,724	78	5,009	25	3.1
Seattle, WA	617,334	84	7,358	34	2.5
Baltimore, MD	621,342	81	7,671	38	2.1
Philadelphia, PA	1,525,006	134	11,379	61	2.2
Average	**758,177**	**85**	**8863**	**39**	**2.3**
Washington, DC	632,323	68	10,298	33	2.0

Table 28. Comparison of Frontline Fire/EMS Apparatus

JURISDICTION	POPULATION	ENGINES	TRUCKS	AMBULANCES	SQUADS
Boston, MA	636,479	34	23	N/A	2
Oakland, CA	390,724	24	7	N/A	1
Seattle, WA	617,334	34	12	7	1
Baltimore, MD	621,342	30	17	24	4
Philadelphia, PA	1,525,006	56	27	50	3
Average	**758,177**	**36**	**17**	**27**	**2**
Washington, DC	632,323	33	16	39	3[25]

Table 29. EMS and Other Features

JURISDICTION	TOTAL NUMBER OF NON-EMS CALLS	TOTAL NUMBER OF EMS CALLS	RAPID RESPONSE CAPABILITY	NUMBER OF MECHANICS EMPLOYED	ANNUAL BUDGET	SQUARE FOOTAGE OF SHOP
Boston, MA	39,205	34,766	Yes	12	$4,339,558	23,700
Oakland, CA	22,000	45,000	No	6[26]	$2,700,000	13,000[27]
Seattle, WA	12,500	69,000[28]	Yes	11	$3,267,726	15,248
Baltimore, MD	27,550	134,147	No	0	None[29]	None[30]
Philadelphia, PA	45,419	231,520	No	21	$47,000,000[31]	12,000
Average	**29,325**	**102,867**		**10**	**$2,061,456**	**12,790**
Washington, DC			No	15	$1,700,000	28,320

[25] For comparison purposes, only heavy rescue squads are considered here, although elsewhere in the report the term "squad" encompasses heavy rescue squads, hazardous materials companies, and the CISU.

[26] Oakland Fire Department has three mechanics on staff and three "service workers."

[27] 13 bays, including those for street sweepers and city vehicles.

[28] City contracts with AMR for BLS transport calls, which range between 25,000 and 30,000 per year.

[29] City Fleet Services is the responsible party for Baltimore Fire Department fleet management budget.

[30]. Square footage is for entire city fleet and unavailable.

[31] Total for entire Philadelphia fleet. No data available for PFD only.

5.1.1.2 *Replacement and Maintenance*

Table 30. Replacement and Maintenance Factors

	YEARS ON FRONTLINE	YEARS IN RESERVE	FRONTLINE PM FREQUENCY	RESERVE PM FREQUENCY	AVERAGE MILES/YEAR	AVERAGE ENGINE HOURS/YEAR
Boston						
Engines	Depends on usage/condition – max. 15 yrs.	Depends on usage/condition – max. 25 yrs.	Per manufacturer specifications	Per manufacturer specifications	1,132	160
Trucks	Depends on usage and condition – max. 15 yrs.	Depends on usage/condition – max. 25 yrs.	Per manufacturer specifications	Per manufacturer specifications	1,185	177
Squads	N/A	N/A	N/A	N/A	N/A	N/A
Ambulances	N/A	N/A	N/A	N/A	N/A	N/A
Baltimore						
Engines	15	5	6 months	6 months	Unknown	Unknown
Trucks	15	5	6 months	6 months	Unknown	Unknown
Squads	15	5	6 months	6 months	Unknown	Unknown
Ambulances	3	3	45 days	45 days	Unknown	Unknown
Seattle						
Engines	13	5	Every 6 months or 4,000 miles	Every 6 months or 4,000 miles	7,113	583
Trucks	12	6	Every 6 months or 4,000 miles	Every 6 months or 4,000 miles	5,188	443
Squads	N/A	N/A	N/A	N/A	N/A	N/A
Ambulances	5	3	4 months or 2,000 miles	4 months or 2,000 miles	13,521	N/A
Philadelphia						
Engines	16	9	2 times/year	2 times/year	7,000	N/A
Trucks	16	7	2 times/year	2 times/year	4,500	N/A
Squads	16	7	2 times/year	2 times/year	4,500	N/A
Ambulances	8	5	4-6 times/yr.	4 times/year	18,000	N/A
Oakland						
Engines	15 (goal)	16-20 (replaced after 20)	1 annual/bi-annual service for every vehicle	1 annual/bi-annual service for every vehicle	7,000	700
Trucks	15 (goal)	16-20 (replaced after 20)	1 annual/bi-annual service for every vehicle	1 annual/bi-annual service for every vehicle	5,000	550
Squads	10-15	16-20 (replaced after 20)	1 annual/bi-annual service for every vehicle	1 annual/bi-annual service for every vehicle	1,000	120
Ambulances	N/A	N/A	N/A	N/A	N/A	N/A

Table 31. Outsourcing of Fleet Repair Work

	PHILADELPHIA	BOSTON	BALTIMORE	OAKLAND	SEATTLE
Agency contracts out apparatus maintenance (including receiving services from other government agencies)	No	Yes, on a limited basis[32]	Yes	Yes	Yes
Outside contractors perform maintenance in government-owned facilities/property	N/A	No	Yes	Yes	No
Types of apparatus outsourced	N/A		Engines, Trucks, Squads, Ambulances, Light Trucks, Command/ Passenger	Engines, Trucks, Squads	Engines, Trucks, Ambulances, Light Trucks, Command/ Passenger

5.2 People Issues

This section will explore issues relating to human resources of the AD and Shop, including the organizational structure of the Division, management and supervision, staffing levels, personnel qualifications and training, workforce morale, and safety.

5.2.1 Organizational Structure, Leadership, and Management

The current organizational structure of the Apparatus Division is depicted in Figure 31.

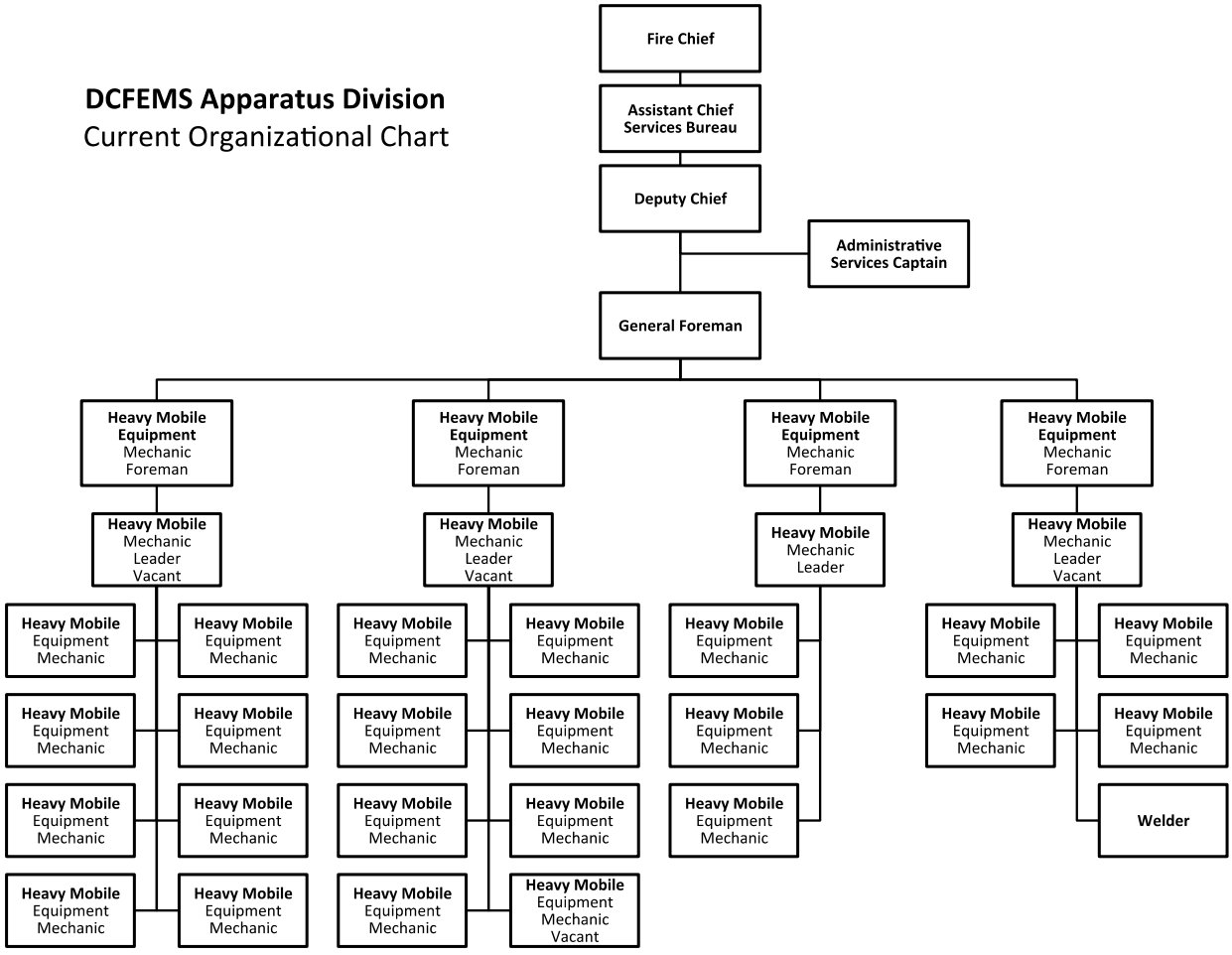
The Division is headed by two uniformed personnel – a Deputy Chief, who reports to the Assistant Chief for Services, and an Administrative Services Captain, who reports to the AD Deputy Chief. Middle management, supervisory, and mechanic positions in the Shop are staffed by civilian personnel – not uniformed firefighters. The Shop floor is run by a General Foreman. He reports directly to the Deputy Chief and the Administrative Services Captain. The General Foreman oversees four foremen, each of whom supervises a crew of between four and seven Shop personnel. All foremen are D.C. Management Supervisory Service personnel.

The Shop has a cadre of foremen, mechanics and recently hired support personnel. Civilians, however, are often seen as auxiliary personnel rather than integral to the effective management of the organization. Intentional or not, contributions by civilian staff members are not held to the same esteem as those of ranking uniformed personnel. Likewise, the culture of senior fire officials is to focus their primary attention on fire operational matters often at the expense of understanding and addressing management-related issues or truly understanding the vagaries, formulas and complexities of fleet management. This is further reflected in the attitudes of

[32] Contracts out work on engines and trucks as needed based on the nature of the work (accident repair, body work, etc.) or shop workload. Majority of work is done in house.

uniformed personnel's view of the civilian personnel in the department. Many firefighters of all ranks have a general negative view of Shop personnel because of the recurrent problems with unrepaired apparatus, continuous breakdowns, repair downtimes, and reported things that need fixing and are either put off again and an again, or never addressed at all. Perception is everything in the fire service, and one is only as good as the last fire extinguished or last person saved – or the last piece of apparatus fixed.

Figure 31. Current Apparatus Division Organization (as provided by FEMS)



5.2.1.1 *Apparatus Division Leadership*

Currently, a uniformed Deputy Chief heads the AD, rather than a professional civilian fleet manager. This has been the practice as far back as anyone can remember. The rationale for the fleet being overseen by a uniformed fire service member is that firefighters are best equipped to understand and implement the fleet needs of a fire department because their knowledge of EMS and firefighting demands, constraints, methods, and tactics makes them better understand the maintenance standards and requirements of the fire and emergency medical services

While this logic seems convincing at first blush, the reality is that it is far easier to teach a professional fleet manager the few things she or he needs to know about the fire service than it is to teach a fire service professional about how to manage a fleet. Fleet management is its own profession, and it is part art and part science. Today's fleet managers need to know about customer service, information technology, accounting, purchasing, vehicle storage, preventative maintenance and repair of different classes of vehicles, and inventory management and reporting. Managing a modern fleet is more akin to running a large business than it is to responding to medical emergencies or putting out fires.

Furthermore, having a uniformed firefighter head the AD can lead to instability in its leadership because uniformed personnel are subject to frequent reassignment. Just within the last year, three different Deputy Chiefs have headed up the AD. By the time that a new AD Chief has become knowledgeable about and is comfortable with his new role, that Chief is replaced. The role of Fleet Director is too important and too technical to have this level of turnover.

5.2.1.2 *The Role of Foremen*

The General Foreman and the supporting foremen have key roles in ensuring smooth and efficient Shop operations, including fostering an effective and harmonious team. Proactive management and supervision are required to provide and enforce AD goals, improve systems, ensure adherence to written policies and procedures, and oversee, train, and evaluate employees. Most importantly the foremen must make sure wrenches are being turned consistently and efficiently and that repairs and PM are being accomplished seamlessly while meeting quality and timeliness expectations. This can only be accomplished through sustained, hands-on supervision of mechanics on the floor.

The supervision of mechanics is best accomplished by meeting two criteria: the number of technicians supervised and the quality of the supervisor. If there are too many mechanics, foremen cannot reasonably oversee the work performed. Conversely, if there are too few mechanics, work will pile up and overwhelm the system.

Similarly, if a foreman is tasked with too many ancillary tasks such as paperwork, answering the phone, fielding complaints, ticket writing, and other administrative duties, his or her effectiveness is further reduced. In the past, too much of the foremen's time was spent on these duties, but as FEMS has recently hired new administrative personnel to perform many of these tasks, foremen's time should be freed up to supervise the Shop floor. This should increase productivity, permit better quality control (QC), decrease out-of-service time, and facilitate PM – which is probably the most critical element in the health and functionality of the FEMS fleet. That said, other factors surely contribute to a lack of productivity in the Shop, including availability of work space, parts, and manpower.

Our observations, coupled with data gleaned from FASTER, leads the Project Team to conclude that there is an opportunity to add more clearly defined roles and responsibilities and more effective segregation of duties to achieve improved control and operational results.

5.2.1.3 *The Role of Organizational Structure and Management in the Success of the Shop*

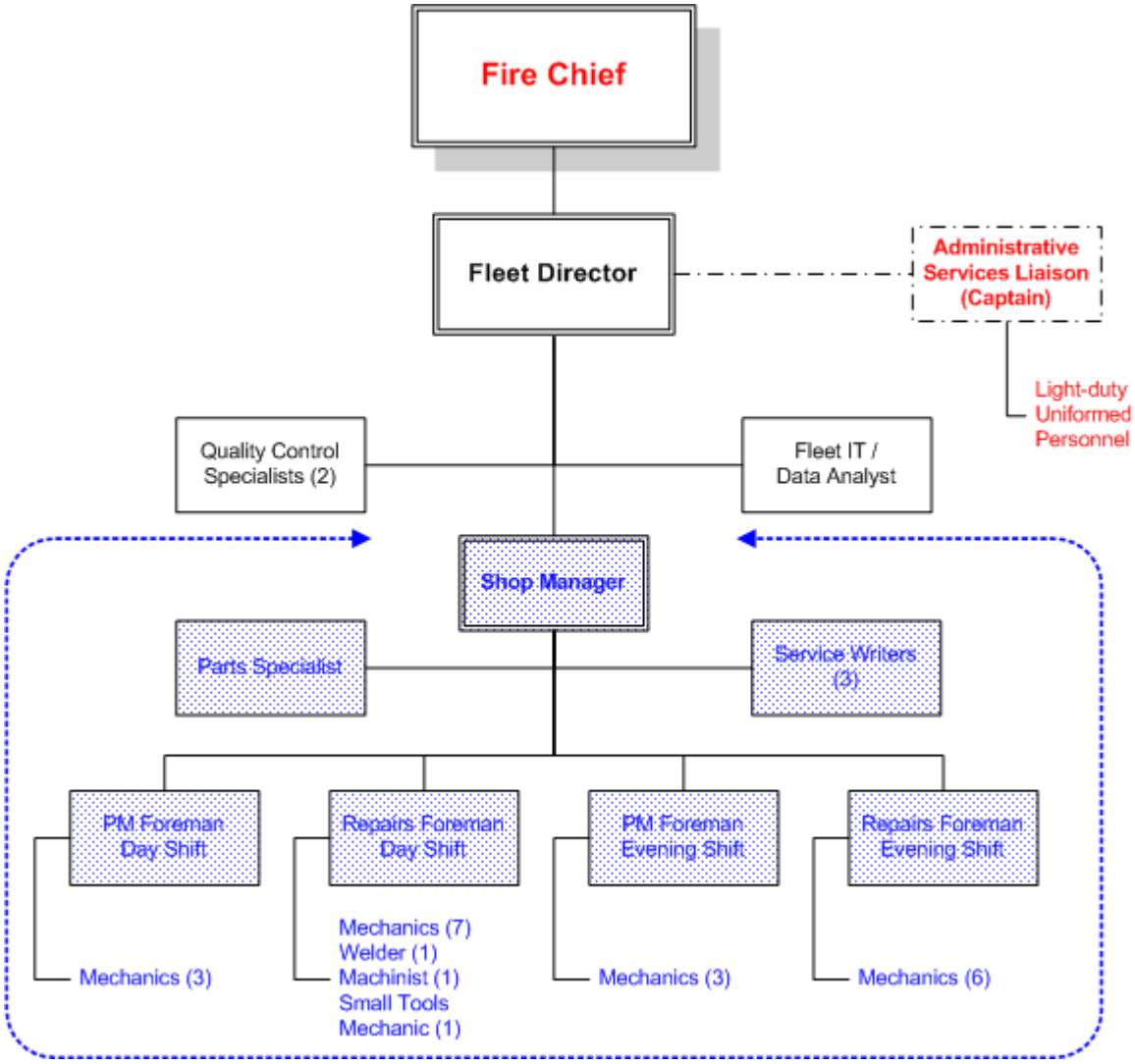
The organizational structure sets the tone for success or failure in a fleet management system through the implementation of systems, procedures and processes. The organizational structure of a fleet program therefore determines the responsibilities and accountabilities for each employee. Job duties should be well defined and within the capabilities of the mechanics in the Shop and occupying their positions accordingly. Currently that structure is fractured, ineffective and inefficient.

There are efforts underway to improve the operations of the AD; however, fixing the AD is a monumental undertaking given the problems that have been festering there for years. Additionally, many of the problems we note in this report are beyond the control of the mechanics and foremen on the floor or the AD administrative staff. Until major organizational and management challenges are addressed, however, many of these other problems will not be fixed. One change that must occur is a revamping of the organizational structure of the Division, beginning with the hiring of a qualified, professional Fleet Director.

5.2.1.4 *Proposed Organizational Structure*

The Project Team believes that the current organizational structure hampers good control and accountability within the AD. A new structure with some entirely new positions and responsibilities is needed. Figure 32 depicts an organizational structure – headed by a civilian fleet professional – that will promote better efficiency and accountability. Uniformed personnel are depicted with in red type.

Figure 32. Proposed Organizational Chart



Following are proposed new positions and brief descriptions of their roles:

- **Fleet Director** – will report directly to the Fire Chief and oversee the entirety of fleet operations, maintenance, budgets, vehicle purchases and disposals, and oversee approximately 500 vehicles, including heavy duty apparatus, ambulance units, and equipment. Provides supervision and direction for foremen, QC officer and IT/Data Specialist in the fleet management system and contractual supervision of outsourced services. Establishes and oversees written policies, procedures, and systems in the AD.
- **Administrative Services Liaison (Captain)** – acts as the liaison between the Fleet Director and uniformed personnel, to incorporate EMS and firefighting demands, constraints, methods, and tactics in establishing and complying with maintenance standards and requirements. Will assist in analyzing budgets, vehicle purchases, etc.

This position will also oversee and direct light-duty personnel detailed to the AD. The oversight of light-duty personnel is a key function of this position.

- **Quality Control (QC) Specialists** – Two QC specialists – one per shift (see Sections 5.2.4 and 5.3.6) – will be responsible for performing QC inspections on all repairs and maintenance performed by AD mechanics and contractors. Ensures FEMS repair and maintenance quality standards are maintained. The QC Specialist on each shift will work with foremen to maintain quality standards and ensure mechanics meet repair time requirements.
- **Fleet IT/Data Analyst** – will act as the FASTER administrator and oversee the analysis and extraction of data, provide management reports, business intelligence to measure performance, and present those findings daily to the Fleet Director. Will provide user information, assistance and training, and act as the liaison between the fleet users, the DPW Support Group (if this system arrangement is to be continued), and the application support team from FASTER *Asset Solutions*. Will capture relevant, accurate information at the appropriate levels of the organization and then to use that information throughout the organization to measure and outline identified goals and priorities. (See Section 3.1.1 for details on the importance of this position.)
- **Shop Manager** – will oversee all functions of the Shop as well as all foremen and mechanics. Will oversee daily operations, fleet shop reporting, monthly reports and maintenance schedules, weekly overdue preventative maintenance reports, and compliance with and reporting on D.C. Department of Motor Vehicles inspection requirements. Will work closely with QC Specialist, and Fleet IT/Data Specialist to produce up-to-date daily fleet status and analysis reports for Fleet Director. If the Department were to decide to contract out Shop services (see Section 5.2.5.3), this position would act as the Contract Program Manager.
- **Parts Specialist –** will act as the central purveyor of the parts necessary to effect repairs, and make them readily available to mechanics on a daily basis. Will maintain an up-to-date inventory of parts in the FMIS. Will maintain and oversee an effective parts inventory system which tracks the use of parts to work orders. Will ensure parts are ordered according to pre-set minimum stock levels.

The reader will notice that the organizational chart depicts two shifts with two foremen on each shift. The rationale for this is discussed fully in Section 5.2.4.

5.2.1.5 *Summary of Findings*

43. The current organizational structure of the AD is one of the main barriers to effective fleet management system in FEMS.
44. A fleet industry professional is needed to lead and oversee the implementation of new procedures, processes, and systems in the AD. The AD's current organizational structure

fosters discontinuity in the AD's programs and effectiveness because the AD leadership is always changing.

5.2.1.6 *Recommendations*

49. FEMS should hire a professional, civilian Fleet Director with relevant qualifications to head the AD.
50. The Fleet Director should report directly to the Fire Chief, not the Assistant Chief of Administrative Services. This direct reporting line will be particularly important in ensuring the AD's transition to becoming a more efficient organization.
51. The AD should be restructured, as described in Section 5.2.1.4. New position descriptions should be developed to support realigned and newly created positions.

5.2.2 Staffing Levels

Currently there are 15 heavy duty mechanics working around the clock on three shifts in the Shop.[33] Throughout the interview and inventory processes, we heard repeatedly (from all levels of the organization – from senior administration officials to mechanics on the Shop floor) that the AD needs more mechanics for the amount of work that needs to be done. This notion is partially correct and partially incorrect, and the explanation for this is not simple.

5.2.2.1 *Computing the Number of Mechanics Needed*

Maintenance and Repair Unit (MRU) analysis is a technique used to estimate the staffing hours required to match the workload. To start, each different type of vehicle in the fleet is assigned a Vehicle Equivalency Unit (VEU) value. A standard passenger sedan is assigned a value of 1.0, and other vehicles are assigned values relative to that. For example, a typical fire engine requires approximately eight times as much maintenance work as a passenger sedan, and thus is assigned a VEU of 8.0. Ambulances require approximately five times as much work as a sedan and are assigned a value of 5.0. Table 32 identifies VEU values for the FEMS fleet.

Table 32. VEU Values for FEMS

VEHICLE TYPE	VEU
Engines	8.0
Aerials	9.0
Squads	6.0
Ambulances	5.0
Buggies	1.5
Trailers	0.5
Sedans/SUV's	1.0
Misc. Trucks	2.0
Other (forklifts, Gators, etc.)	0.5

[33] At the time this report was written, two mechanics had recently resigned, bringing the mechanic workforce down to 15 from 17.

According to fleet industry standards, a standard passenger sedan requires 10 to 15 hours of maintenance annually. The value varies based on many factors, including but not limited to, age of the vehicle, climate, topography, road conditions, and workload. For FEMS vehicles, a reasonable value is 14 hours. With this number, the total annual workload required to maintain the fleet can be estimated. As Table 33 depicts, mechanics need to be turning wrenches on FEMS equipment a total of 19,705 hours annually. Two more factors must be considered in determining the number of personnel required to accomplish this objective: the amount of work contracted to other sources[34] and mechanic productivity (i.e., the percentage of time that mechanics actually turn wrenches).

Table 33. Direct Mechanic Hours Needed

VEHICLE TYPE	NUMBER OF UNITS	VEU	VEU SUBTOTAL	HOURS PER VEU	DIRECT MECHANIC TIME (HRS.)
Engines	53	8.0	424.0	14	5,936
Aerials	26	9.0	234.0	14	3,276
Squads	9	6.0	54.0	14	756
Ambulances	93	5.0	465.0	14	6,510
Buggies	26	1.5	39.0	14	546
Trailers	20	0.5	10.0	14	140
Sedans	86	1.0	86.0	14	1,204
Misc. Trucks	45	2.0	90.0	14	1,260
Other (forklifts, Gators, etc.)	11	0.5	5.5	14	77
TOTAL					**19,705**

Mechanic productivity is calculated by dividing the number of hours a given mechanic spends actually working on vehicles by the number of hours that the mechanic could potentially spend working on vehicles in one full work year (2,080 hours). No mechanic actually works on vehicles for all 2,080 hours in a work year. Time spent doing administrative work, in meetings, on annual or sick leave, in training, etc. reduces the time available to turn wrenches. Industry standards suggest that "efficient" mechanics generally have productivity near 70%.[35]

Unfortunately, the data necessary to calculate FEMS' mechanic productivity are not available because mechanics do not correctly log their time in FASTER.[36] Because data on FEMS

[34] FEMS contracts with many other entities to maintain the fleet. Some of these entities are other District organizations, such as DPW and D.C. Water. Other entities include outside vendors, such as fire apparatus suppliers, automobile dealerships, and many others. Data being collected by the FASTER system and through other venues are not adequately coded to identify the percentage of work handled in-house versus that being outsourced.

[35] Owen, R., "Calculating Mechanic Staffing Requirements," *Government Fleet*, Nov./Dec. 2009, p. 31

[36] We know this because of the wide ranges of time logged by each mechanic. Mechanics are supposed to clock in and out of FASTER each time they work on a given vehicle. As a matter of practice, however, this is not happening. Some mechanics logged as many as 2,738 hours in a 2,080 work year, whereas other logged as few as 385 hours over the same time span. For a mechanic to log 2,700 hours of wrench-turning time at even 65% productivity would mean that the mechanic would had to have been at work for 4,153 hours – almost exactly twice the number of hours in a normal work year (52 weeks @ 40 hours/week = 2,080 hours). Because the mechanics' time data are suspect, we cannot determine with certainty their productivity.

mechanics' productivity is unreliable, we calculated how many mechanics would be needed to produce 19,705 wrench-turning hours in an industry-standard shop with mechanics who are 70% productive. If one assumes that FEMS mechanics are 70% productive, then 14 mechanics are needed for this volume of work.[37] Based on the Project Team's observations at the Shop, we believe the actual productivity rate to be lower, but we cannot quantify what the actual rate is.

Even at its current staffing level of 15, FEMS has more mechanics than do the fire departments in the comparison cities (see Table 29).[38]

When one looks solely at the numbers (either calculated or comparative), FEMS has a sufficient number of mechanics for the imputed workload; however, the algorithmic approach to calculating the number of mechanics needed assumes that a shop operates efficiently and that its mechanics would be considered productive according to most industry standards. ***This is clearly not the case for the FEMS Shop.***

Given the current state of disrepair of the fleet, the actual demand for maintenance and repairs is probably significantly *higher* than the 19,705 hours imputed by the MRU analytical approach (although the data in FASTER are not sufficiently reliable to calculate what that actual number would be). Moreover, there are myriad problems with the AD's processes and operations that hamper mechanic productivity. In the short run, this means that the number of mechanics needed is artificially higher than it would be were these issues not present. Once problems with the fleet inventory and Shop productivity are addressed, the number of mechanics needed will be lower, but this could take a year or more to correct.

In other words, to answer the question of how many mechanics are needed, one must view the solution as occurring in two phases. In the first phase (right now), as many as four more mechanics are needed to deal with the high demand for service and low efficiency of the Shop. In the second phase (once things improve), 14 mechanics will be needed for a fleet of the present size and distribution by type of apparatus.

5.2.2.2 *Summary of Findings*

45. Data collected by FEMS through FASTER does not accurately reflect hours worked by FEMS mechanics or outside vendors.
46. With 15 mechanics, the Shop is understaffed for the present demand for maintenance and repair services. Once needed improvements are made to the fleet inventory and the Shop is running more efficiently, 14 mechanics should suffice.

[37] 19,705 hours/year divided by 1,465 hours/year/mechanic = 13.53 mechanic. This calculation uses a 70% productivity rate, or 1,465 hours/year/mechanic.

[38] Excluding Philadelphia, which has a shop that services the entire city fleet.

47. As discussed in Section 3, fleet management information systems, the lack of available data is a *significant* issue for FEMS management. It is impossible to identify needed staffing levels accurately when one cannot track hours worked by existing staff or the amount of work conducted by vendors.

5.2.2.3 *Recommendations*

52. Mechanics must accurately log the time they spend on each repair. This may require additional training on the proper use of the FASTER system to log repairs at the time they are performed.
53. Hire four additional mechanics to fill the immediate gap in Shop's ability to meet the demand for service. As improvements are made to the FEMS fleet and the AD operations, the number of mechanics should be allowed to float down to 14 through natural attrition.

5.2.3 Mechanic Accountability

As discussed in Section 5.2.1.2, there is an unacceptable lack of activity in the Shop. This is a function of poor oversight of floor activities by the Shop foremen but also a lack of any system of performance management. There are no clearly stated expectations for how long various repairs and maintenance should take (in commercial automotive repair settings, these expectations are set forth in the form of "book time"). Additionally, because mechanic timekeeping in FASTER is haphazard, the AD lacks the ability to review individual mechanics' productivity against a set of objective, quantifiable criteria governing how long each type of repair should take. This means that there is no basis to hold the mechanic accountable for the time he is taking on the work he is doing.

Additionally, since there is no QC inspection of mechanic work, there is no way to determine whether a given mechanic's work is of satisfactory quality. Highly performing shops regularly assess the "come-back" rates (i.e., how often a vehicle comes back to the shop for the same repair within a certain time period) for each mechanic. FEMS does not examine this – or any other – metric for its mechanics.

Because there is no objective measure of mechanics' performance, mechanics are not routinely held accountable for their throughput or the quality of their work. Because the foremen do not appear to be regularly engaged in overseeing the work on the floor, mechanics have no incentive to stay on top of their work.

5.2.3.1 *Summary of Findings*

48. No identifiable performance expectations have been communicated to Shop personnel.
49. Shop personnel are not keeping accurate track of their time in FASTER.

50. Shop personnel are not routinely held accountable for either the timeliness or quality of their work.

51. AD managers are not routinely using FASTER to monitor the productivity and performance of the Shop.

5.2.3.2 *Recommendations*

54. Management-based performance metrics should be established for Shop personnel. Such metrics would provide a framework for developing performance goals and for measuring personnel performance.

55. AD managers should be using FASTER on a daily basis to monitor the productivity and performance of the Shop.

56. Managers must hold mechanics accountable for the timeliness and quality of their work. In addition to developing and deploying performance metrics, it is important that standard operating procedures for continuous monitoring and feedback are developed.

57. Training on proper use of FASTER to track time must be delivered.

58. QC checks should be performed on all work at the time of completion. Work that fails to meet quality expectations should be corrected.

5.2.4 Number of Shifts Worked

The Shop is currently staffed on all three shifts. The rationale for having the Shop open on a 24/7 basis is:

1. the volume of repairs and maintenance necessitates working around the clock; and
2. Shop personnel need to be on duty at all times to be able to provide emergency road service (i.e., towing, jump starts, etc.).

At first blush this seems justifiable; however, when this operating mode is considered fully, it actually does not make sense.

It is true that FEMS currently faces an extraordinary backlog of repairs and maintenance. While it is tempting to think that the way to address this problem is to work around the clock to keep up with the demand for services, the real solution is to work smarter, not longer, hours (Section 5.3.7 discusses our approach to eliminating the backlog). There a number of key flaws in the logic about working around the clock:

1. Analysis of mechanic time in FASTER strongly suggests that the night shift is not as productive as either the day or evening shifts.[39] This is partly due to lower staffing levels

[39] 13% of total labor recorded in FASTER during the last 6 months was recorded on the night shift; 56% was recorded on the day shift; and 32% was recorded on the evening shift.

on the night shift, but more likely a function of the quality of shift supervision and mechanic oversight.

2. Since the parts department is not open at all times, after-hours repairs must be put on hold if a needed part is unavailable.
3. Manufacturer's support/consultation resources are not open at night, meaning any repair requiring such resources must be deferred until they are open anyway.
4. Thin staffing on the night shift is a safety issue, as workers reportedly frequently end up working alone in the Shop. Additionally, some repairs are more easily accomplished with more than one mechanic. This help is more difficult to obtain if they shift is thin.
5. Any work requiring a machinist or welder cannot be accomplished because those personnel do not work at night.

Additionally, the rationale that Shop personnel need to be able to provide road service does not provide sufficient grounds to keep the Shop open around the clock. The real solution to a need for 24/7 road service is to contract with a towing company to provide such services on an as-needed basis. The main reason for doing this is to keep Shop personnel working on vehicles. Pulling Shop personnel from the floor to provide road service keeps them from their primary mission. In terms of value-added, an experienced mechanic adds more value turning a wrench than towing a vehicle. The latter can be done by someone who does not possess the highly specialized knowledge that a mechanic has.

Often it does not make sense to undertake a repair or a step of a repair process, if the work cannot be completed in the time available. In this respect, interruptions in the form of road service requests can delay the completion of some repairs because there is no point in starting new work once the mechanic returns to the floor.

Finally, studies of multitasking have clearly demonstrated that when people are interrupted – even for a moment – from a task that demands attention, they lose focus and have to take additional time to get back up to speed on the task.[40] This applies to the work that mechanics do, and it argues against interrupting them to provide road service.

5.2.4.1 *Moving from Three Shifts to Two*

The Project Team is not aware of any other fleet shop (emergency services or not) that works three shifts. In terms of best practices that we have researched and observed, we believe that elimination of the night shift should be considered, as should elimination of weekend hours. We believe these changes would offer some real advantages.

[40] See, for example, some of the studies mentioned in http://www.thenewatlantis.com/publications/the-myth-of-multitasking

The most important is that it would provide two foremen per shift to oversee Shop operations. One foreman could oversee repairs and the other PM. Having two foremen would enable each to engage more with the mechanics they supervise. The administrative aspects of running each shift would be spread out, and they would serve as a backup for each other when one was absent.

Moving to two shifts would also bolster staffing on the day and evening shifts because the personnel currently assigned to the night shift could be transferred to one of the two remaining shifts. This would mean that more personnel would be available to do tasks that require more than one mechanic.

Additionally, shutting down the night shift would result in financial savings in terms of reductions in overtime and electricity costs.

The same arguments apply for the elimination of weekend hours.

5.2.4.2 *Summary of Findings*

52. Keeping the Shop open on a 24/7 basis does not improve Shop throughput.
53. Mechanics working the night shift do not receive adequate supervision or support.
54. Mechanics working the night shift frequently work alone – a dangerous practice.
55. Pulling mechanics from the Shop floor to provide road service interferes with maintenance and repair operations.

5.2.4.3 *Recommendations*

59. Terminate night and weekend shifts, and reassign the workers on the night shift to the day and evening shifts.
60. Assign one foreman on each shift to lead repair operations and the second foreman to lead PM.

5.2.5 Contracting for Fleet Management and Repair Services

This report would be incomplete without discussing the concept of FEMS outsourcing fleet management and repair services. Contracting is used in many best-practice fleet operations. The Project Team was impressed by the organization, functioning, and level of commitment readily apparent in the MPD Shop – an operation which is outsourced. Additionally, the Project Team was impressed by the BFD's use of contracting for its parts supply.

5.2.5.1 *Outsourcing in the Metropolitan Police Department Shop*

The MPD Shop is run – from top to bottom – as a business. The MPD Fleet Director is a career fleet management professional, as is the contractor's lead. The MPD Shop is a customer service-based system, and each and every protocol, procedure, system, and performance measure is geared toward and predicated on productivity. PM and worker safety are consistent philosophies

and preeminent goals of the MPD Shop. Measuring the productivity and performance of every mechanic is performed daily through the proper use of FASTER. QC is built into the system with appropriate checks and balances at all levels of the hierarchy (both within the contractor's operation and within MPD's). The administration of the MPD Shop thoroughly understands the demands placed on the vehicles under its auspices, but it also understands the factors outside of its control, such as the parts supply chain, and it has contingencies in place to address those factors in the same way that companies such as Hertz or Avis do in their operational models. For example, according to the MPD Fleet Director, the MPD contractor orders more tires than would otherwise be needed in the month preceding the Daytona 500 race, because the contractor knows that its tire manufacturer shuts down all operations for a month and focuses exclusively on supplying that race. This kind of detailed industry knowledge is critical to keeping a fleet running and to the success of MPD's operation.

The contrasts between the two operations are starkly evident. It is true that the MPD Shop focuses almost exclusively on light- and medium-duty vehicles; however, the business practices, use of management information, and level of professionalism provide a readily accessible model for FEMS to consider seriously.

5.2.5.2 *Parts Operation Outsourcing in the Boston Fire Department Shop*

The BFD outsources its part inventory and ordering processes. The BFD Deputy Commissioner of Administration and Finance indicated that this has proven extremely beneficial for a number of reasons. First, the BFD does not bear the cost of the inventory until a part is actually used on a vehicle. Second, parts are available immediately because the contract specifies parts availability reliability. Third, the system allows the BFD to more accurately and economically match the cost of inventory with its operational needs. This is a best practice that FEMS also needs to strongly consider adopting.

5.2.5.3 *Outsourcing Options Available to FEMS*

Positions in the AD that could be outsourced are depicted in shaded blue squares and/or blue type in Figure 32 (on page 101).

There are four basic approaches to outsourcing all or part of the Shop operation that FEMS could pursue:

1. Outsource everything, including work order creation, PM and repairs, and parts inventory control and ordering, for all classes of vehicles.
2. Outsource all light- and medium-duty apparatus PM and repairs, retaining only heavy-duty apparatus maintenance and repairs (see Section 5.3.2.4).
3. Outsource the parts operation (see Section 5.3.2.6).

4. Establish an SLA with MPD or other suitable agency for the maintenance and repair of light-duty apparatus (see Section 5.3.2.7).

Consideration of any outsourcing model would require a detailed cost analysis and feasibility study to weigh out the pros and cons of such a momentous change in the way the AD does business, and this is well beyond the scope of the current study. The MPD underwent this transformation several years ago, and its leadership would be an extremely valuable resource to guide FEMS in such a study and possible change.

We believe that higher quality operations and results could be obtained by outsourcing the operations of the Shop (option #1, above). Outsourcing in this manner affords FEMS a rapid way to obtain a professional fleet industry management and operation of the Shop. The primary advantage of outsourcing the entire operation is that a private-sector vendor has a built-in financial incentive to hold foremen and mechanics accountable to meeting performance objectives. This incentive is not present in the public-sector setting as it now exists. A professional fleet management vendor will need to put new processes, procedures, and metrics in place. The vendor will have the expertise and experience to accomplish this rapidly (presumably, this will be demonstrated in the selected vendor's prior performance and client references). FEMS will be able to work collaboratively with the vendor to establish service expectations, and the vendor will decide how many personnel it needs to provide in order to meet those expectations. A strategic system of performance awards would aid in making the contract attractive to national, reputable service providers. FEMS could also specify that the winning vendor would need to hire incumbent mechanics whenever possible.

At the *very least*, the AD should divest itself of all responsibility for servicing light- and medium-duty apparatus, as these repairs can almost always be done at a vendor's shop. It makes no sense for heavy-duty mechanics to perform maintenance and repairs on light- and medium-duty equipment when such servicing can be accomplished by mechanics with training and experience appropriate to light- and medium-duty vehicles. Splitting off these two classes of vehicles will lessen the Shop's workload and allow FEMS mechanics to focus on the most mission-critical equipment.

5.2.5.4 *Summary of Findings*

56. Outsourcing represents a faster and more comprehensive means to afford the AD the expertise, professionalism, and quality performance it so urgently needs.
57. Outsourcing of light- and medium-duty vehicles is a viable means to decrease the AD workload and to keep the Shop focused on providing services that are mission-critical and more difficult to obtain elsewhere.
58. There are other fleet operations in D.C. Government and the region with which FEMS could establish an SLA to perform certain repairs.

5.2.5.5 *Recommendations*

61. FEMS should undertake a feasibility study of the use of a contracted fleet management system similar to the one in use in MPD.
62. If the decision is made not to contract out all Shop services, then FEMS should explore other opportunities to contract out for services, including for light- and medium-duty vehicles, towing, and parts supply.

5.2.6 Personnel Qualifications and Training

Over the last 10 years, the emergency services fleet industry has evolved in terms of professional competencies. Where firefighters on formerly performed a lot of repairs on fire apparatus, the national trend has strongly evolved towards using professional mechanics with automotive and emergency vehicle technician certifications. The two leading certifications are Automotive Service Excellence (ASE) and Emergency Vehicle Technician (EVT). In order to keep abreast of changes in complex technologies, diagnostic tools, and repair techniques, it is essential that FEMS mechanics and foremen have these credentials. Requiring mechanics to have obtained ASE certification is the industry standard in the fleet management profession. In the emergency services fleet management arena, EVT has become the preferred standard (in addition to requiring that mechanics have ASE certification).

5.2.6.1 *Lack of Access to Training and Certification*

Training and certification is a sensitive issue among Shop personnel. One of the main concerns of everyone affiliated with the AD was the sore lack of available training. During the course of our interviews and inventory we spoke to both foremen and mechanics about certifications and training. We found that there is not a lot known within the Shop about the levels of certifications personnel have. Many with whom we spoke did not seem to think training was that important in the big picture. Surprisingly, the bulk of that view came from the foremen.

Discussions with mechanics and Shop leadership revealed that many mechanics had not received *any* technical training in several years. Most mechanics do not receive any other formal training other than that which they pursue on their own. The only "training" any of the mechanics and foremen reported receiving on the job was a familiarization offered by original equipment manufacturers (OEMs) upon the acquisition of new units. This does not constitute meaningful training because these sessions are only designed to acquaint mechanics with the location of basic systems and equipment. Familiarizations are not in-depth training on new developments in engineering, and they are too infrequent to keep mechanics apprised of the ever-changing information they need to conduct warranty repairs and stay abreast of industry innovations and trends. Rather, this type of regular, in-depth training should be conducted by OEMs as a contractual requirement for of all future vehicle procurements.

Training in FASTER is another critical area found to be lacking. During our interviews we heard repeatedly and often, from all levels of the organization, that there was a general lack of any significant training in FASTER, resulting in a lack of understanding as to why FASTER is so important to the success of the organization (see Section 3.3.4, specifically the third paragraph). A representative of the DPW FASTER Administrator delivered some training to FEMS personnel, but this occurred some time ago. The training was spotty and has not been as comprehensive or in-depth as it needed to be, as evidenced by the AD's poor utilization of FASTER. This needs to change.

It was apparent to the Project Team that most Shop personnel with whom we talked about training were eager to be trained and were frustrated at the lack of availability or incentives in this respect. Training and certification in ASE and EVT is available elsewhere in D.C. Government and locally in the National Capital Region. DPW has in-house instructors that can be used to train FEMS Shop personnel, and Montgomery County Fire-Rescue's Fleet Division is a National EVT Testing Center. Given the proximity of these resources, it is vital that Shop personnel be able to obtain and maintain the industry-standard certifications of ASE and EVT.

5.2.6.2 *Lack of Documentation of Training and Certification*

When the Project Team requested training records and certification records we were informed that none could be found. Because there are no records, and because those in management positions do not seem to know about the training and certifications of Shop personnel, we cannot report on the number of mechanics in the Shop who have acquired certifications. The Project Team was told that all new and recent hires are required to have these certifications; however, no records were available to demonstrate compliance along those lines. It is equally hard to determine who among the veteran Shop staff has this training, because there is no credible information on certifications mechanics or foremen hold.

Being able to document the training and certification of Shop personnel would be essential in defending the District from a lawsuit alleging mechanic error or negligence on the part of FEMS in not providing suitable training for its Shop personnel. Additionally, mechanics who work on emergency vehicles without proper knowledge (usually demonstrated through certification) can void OEM warranties on expensive apparatus, as warranties often contain specific exclusions based on improper installation, repair, or alterations.

FEMS subscribes to Target Safety, an online learning management system with features that permit delivery of training online as well as documentation of training and certification of fire service personnel. Target Safety should be similarly used for Shop personnel.

5.2.6.3 *Training and Certification Required for Promotion*

One of the possible problems with incentivizing training and certifications in the current system is that all mechanics are the same pay grade irrespective of the training and certification they

may possess. Many years ago, mechanics in the AD were of differing pay grades; however, at present, all mechanics are Grade 11 in the D.C. Department of Human Resources pay classification system because of a collective bargaining agreement passed some years ago. This may act as deleterious disincentive to get additional training at differing or higher levels.

Promotions should require that a candidate possess advanced certifications (e.g., ASE Master Technician and Master EVT) and a demonstrated commitment to training and excellence.

5.2.6.4 *Summary of Findings*

59. There are no records about mechanics' training or certifications.
60. Shop personnel are hungry for training.
61. There is little encouragement or assistance given to Shop personnel to pursue professional training and continuing education.
62. There is little emphasis placed on mechanics obtaining nationally recognized certifications, such as ASE or EVT.
63. Training on FASTER has been inadequate.

5.2.6.5 *Recommendations*

63. The AD should establish as a minimum standard of employment for all current and future mechanics to obtain ASE and EVT certification. An additional requirement should be established that all subsequent promotions of personnel to the foreman level must have, or obtain within a prescribed timeframe, both the ASE Master Technician and Master EVT certifications.
64. The AD should immediately update its records on each mechanic and foreman with respect to training obtained, current certifications possessed, and any needed professional development/continuing education.
65. The AD should use the Target Safety application to track the training and certifications of Shop personnel. Additionally, the AD should explore how Target Safety may be used to deliver relevant continuing education programs to its Shop personnel.
66. Professional Development Plans for all Shop employees should discuss professional standards for productivity and include means for AD personnel to improve their knowledge, skills, and abilities.
67. The AD should create incentives (e.g., tuition reimbursement and pay adjustments) for fleet supervisors and managers to secure certifications from ASE, EVT, American Public Works Association, Association of Equipment Management Professionals, NAFA Fleet Management Association, or other suitable industry associations.[41]

[41] For additional information, see www.apwa.net; www.nafa.org; www.aemp.org

68. The AD should budget for a minimum of 40 hours of technical training per employee annually.
69. The AD should explore the availability of local and in-house training opportunities.
70. The AD should establish an updated and comprehensive training program on the importance of FASTER, its use, why information should be captured, what data should be tracked, and why data are essential to the success of the AD.

5.2.7 Workforce Morale

Early in the study, it became quite apparent that there is a dichotomy in the Shop between some with a strong sense of mission and others who are dispirited. There is, however, no question that the vast majority of personnel are dedicated to FEMS' extremely important Mission and Vision of FEMS which, respectively, are:

> *"… to preserve life and promote health and safety through excellent pre-hospital treatment and transportation, fire prevention, fire suppression and rescue activities and homeland security awareness."*

> *"… to be a performance-based organization in which a well-trained, multi-disciplined skilled workforce utilizes state-of-the-art equipment, technology and apparatus to provide the highest quality of Fire and Emergency Medical Services."*

On the other hand, there is a palpable sense of low morale and disincentive from some personnel, which may be attributed to years of chronic operational dysfunction. Shop personnel appear to receive low prioritization when it comes to organizational support, investment, and recognition. They are in the precarious position of being subject to blame when apparatus fails and face great pressure to repair apparatus when they do. The lack of training (discussed in Section 5.2.6.1) is a good example of the lack of support mechanics feel. So, too, is the fact that Shop personnel need to buy expensive tools (in excess of those they are required to own as a condition of employment) simply to be able to do their jobs. Some mechanics have spent as much as $10,000 on tools during their FEMS employment. These are tools that ordinarily would be provided by the Department, based on our past experience.

There continues, however, to be an esprit de corps among the Shop personnel – stronger than one might expect given the conditions under which they work. The people with whom we spoke espoused a desire to do the right thing and to keep FEMS apparatus on the road because they recognize the pivotal role the fleet has in the delivery of critical fire and emergency medical services. This is extremely laudable given conditions at the Shop.

The project team additionally found that there are HVAC, housekeeping, and hygiene issues that make for a challenging work environment. For example, the Shop is filthy, hot in the summer, and is cluttered and dark – in comparison to many other shops we have seen.

5.2.7.1 *Summary of Findings*

64. Esprit de corps among Shop personnel can be considered strong, although morale remains lower than it should be.
65. Poor working conditions and depressing physical surroundings contribute to demoralization.
66. Lack of emphasis on the FEMS mission and vision along with varied levels of training and team spirit has resulted in an uneven sense of purpose and morale.

5.2.7.2 *Recommendations*

71. FEMS should improve the working conditions at the Shop, by making a concerted effort to improve environmental conditions and by taking steps to ensure that all employees are aware of and embrace the FEMS mission, vision, goals and objectives. This could be achieved through targeted training and team building activities.
72. AD leadership should take steps to ensure that the organization takes a mission driven approach to running its operations. This is particularly important as it relates to line level operations and would be a key consideration when developing and codifying standard operating procedures.

5.2.8 Safety

Automotive Shops are dangerous places. High noise levels, hazardous materials used in repair processes, mechanical devices (such as lifts, jacks, and impact wrenches), cutting tools, etc. all pose threats to worker safety. In 2011, the worker fatality rate for automobile mechanics was 3.9 per 100,000 full-time equivalent workers (FTEs) – greater than that of firefighters (2.5 fatalities per 100,000 FTEs).[42] Since 2007, there have been 11 reported fatalities and over 15,000 hospitalizations from injuries from automotive lift accidents.[43] For these reasons (and others), numerous Occupational Safety and Health Administration (OSHA) regulations apply to these vehicle maintenance facilities.[44] OSHA regulations speak to workers' right-to-know (e.g., ensuring Material Safety Data Sheets are available for hazardous materials in use in a shop), personal protective equipment, tool maintenance, workplace cleanliness (e.g., spill cleanup and maintaining work areas free from clutter), and other topics.

The real risks of working in an automotive repair facility notwithstanding, safety appears to be a low organizational priority in the FEMS Shop. From a safety standpoint, the Shop is an accident waiting to happen. Given that FEMS places a high emphasis on safety of first responders, it seems incongruous that FEMS should not carry over this concern to the Shop, where workplace hazards are also abundant.

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[42] U.S. Bureau of Labor Statistics, http://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2011hb.pdf

[43] http://ohsonline.com/articles/2013/06/28/osha-emphasis-program-targets-automotive-lift-injuries.aspx

[44] These are codified at 29 CFR 1910. See https://www.osha.gov/SLTC/autobody/ for a list of regulations.

The Project Team has been in numerous other vehicle maintenance and repair facilities in jurisdictions across the country. In virtually all of these other shops, safety has been of paramount concern and a constant practice. In most places, people entering a shop floor are required to wear safety vests and eye and hearing protection. Eyewash stations and emergency showers are readily identifiable and accessible. Safety is taken seriously.

In none of our numerous visits to the FEMS Shop did we see any common industry safety practices in effect. Shop personnel, uniformed responders, and shop visitors routinely wander around without basic personnel protective equipment such as safety vests (or uniforms with high-contrast, retroreflective striping) and eye and ear protection. The eyewash station at the Shop was hard to locate, filthy, and had spigots which were uncapped (see Figure 33).

It was also reported that oil-saturated ground and asbestos have been discovered at the Shop. Figure 34 shows a work area in the Shop covered in oil and water, both of which pose slip/fall hazards for workers. This photo is a marked contrast to Figure 35, which was taken in the Montgomery County (MD) Fire-Rescue Service's Central Maintenance Facility.

It was reported to the Project Team that Shop personnel frequently work alone on the night shift. This practice is *extremely* dangerous and contravenes basic shop safety practices that would be considered industry norms. If a worker were to become incapacitated for any reason, it might be hours until that person was discovered.

Figure 33. Dirty Emergency Eyewash Station in the Half Street Shop

Figure 34. Slip/Fall Hazard at FEMS Shop

Figure 35. Montgomery County Fire-Rescue Central Maintenance Facility

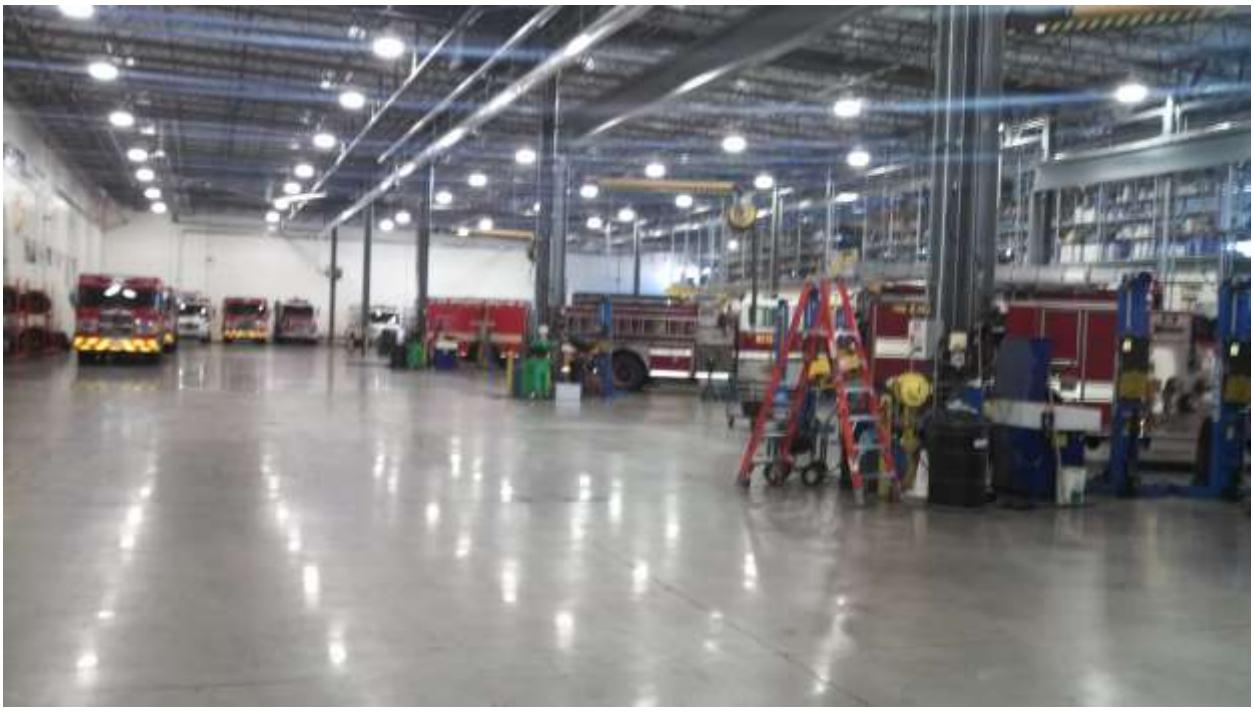


Figure 36. Safety Reinforcement at the MPD Shop

The contrast in adherence to common safety practices between the FEMS Shop and the Metropolitan Police Department (MPD) Shop on West Virginia Avenue, NE is marked, and one need only travel there to see good safety practices in effect. For example, the vendor at the MPD Shop conducts a *daily* safety briefing with all Shop personnel. A safety message of the day is communicated during the briefing, as are lessons learned from accidents which have occurred at other Shops run by the vendor. Mechanics all wear uniforms with high-contrast, retroreflective striping, and even administrative personnel working in the work order writing area wear safety vests. Figure 36 shows an example of the MPD Shop's organizational commitment to safety.

5.2.8.1 *Summary of Findings*

67. Basic safety practices are not in evidence at the FEMS Shop.

5.2.8.2 *Recommendations*

73. FEMS should promulgate and closely enforce a policy on Shop safety. This policy should comport with industry standard practices, applicable portions of NFPA 1500 (Standard on Fire Department Occupational Safety and Health Program), and applicable OSHA regulations.

74. FEMS should ensure that all Shop personnel are issued a complete set of appropriate personal protective equipment and that a sufficient quantity of replacement equipment and disposable items are maintained continuously on hand to ensure that all Shop personnel and visitors are adequately protected at all times when on the Shop floor.

75. Shop personnel should receive regular safety training and updates in accordance with OSHA guidelines and commonly accepted industry practices. This includes any specialized training required to operate lifts, cutting or welding equipment, tow trucks/wreckers, or any other vehicles and/or equipment Shop personnel may be called upon to operate.

76. No one should be permitted to work alone in the Shop at any time.

5.2.9 Driver Training

As noted in Section 5.1, FEMS apparatus accumulate a lot of mileage and engine hours under severe conditions. All classes of apparatus respond on a lot of runs. District streets are congested and can frequently be a rough ride. In combination, these factors take their toll on the apparatus in terms of wear-and-tear.

But there is another problem that contributes to the poor condition of the apparatus – driver abilities. FEMS does not require its apparatus operators to pass the U.S. Department of Transportation's Emergency Vehicle Operators Course (EVOC). Every probationary member of the Department must become certified by the Department as a "driver" before being released from probation; however, this departmental certification is based on the subjective rating of the probationer's company officer and does not meet any national standards.

Furthermore, the process to become a "technician" (the primary driver of a given piece of apparatus on a given shift) does not include an EVOC class or training on the inspection and operation of that apparatus.[45] Technicians in most other departments are expected to be thoroughly knowledgeable about all aspects of the operation, inspection, and in-station maintenance of the vehicle(s) to which they are assigned. This clearly is not the case in FEMS, as a number of technicians with whom we spoke during our inventory process did not know how to access basic information from the vehicles' on-board computers. (This was not a large percentage of the technicians, but it was enough to be noted as a concern.)

Compared with the driver education/certification process of other fire and EMS agencies and with national standards, FEMS driver education/certification is lacking. While we are unable to draw a direct statistical correlation between this gap in driver abilities and its effect on the condition of the apparatus, the collective experience of the Project Team suggests to us that implementation of a formal EVOC program coupled with formal training for technicians on the inspection and in-station maintenance of their apparatus would be helpful in keeping the fleet in better shape than it is.

[45] The process to become a technician involves passing an area geography test for the company's "first-due" area, then passing a written test on pump and hydraulics given at the Training Academy, followed by a practical test on either pump operations (for an engine company) or aerial ladder operations (for a truck company). If the candidate passes both the written and the practical test, then the candidate is administered a driving test. Selection of technicians is based on a combination of test results and seniority (in the Department and in the station).

5.2.9.1 *Summary of Findings*

68. FEMS does not require apparatus operators or technicians to pass an EVOC course as part of their driver training program.
69. Apparatus technicians are not formally trained in the operation, inspection, and basic in-station maintenance of apparatus.

5.2.9.2 *Recommendations*

77. FEMS should implement formal EVOC training for anyone who will operate any emergency apparatus.
78. FEMS should implement a formal technician training program for all technicians. This training should include the vehicle inspection and deficiency reporting process, as well as how the apparatus should be maintained in the station and operated on the road.
79. FEMS should consider authorizing in-station personnel to effect simple repairs such as changing burned-out light bulbs in simple applications found on apparatus. This should not involve the repair of the fixtures themselves, nor include the repair or tampering with any wires connected with those appliances, but minor maintenance tasks only.

5.3 Process Issues

The problems in the AD do not rest solely at the feet of the people who work there. There are numerous process issues that confound the mechanics and administration of the AD. This section discusses some of the most glaring and relevant process issues; however, as the reader is undoubtedly aware, the question of process issues permeates virtually every discussion in this report. Addressing process issues may be easier than addressing some of the other types of problems facing the AD; however, this is not to say that fixing process problems will be easy.

5.3.1 Preventative Maintenance

If the Project Team could identify only one issue to correct, it would be the virtual absence of a PM program in the AD. In every smoothly operating fleet with which the Project Team is familiar, PM is considered a "sacred cow."

5.3.1.1 *Why Preventative Maintenance is Necessary*

The high call volume that FEMS handles takes its toll in wear-and-tear on the apparatus. It is simply impossible to subject apparatus to the 24/7 beating that most FEMS vehicles endure, not maintain them, and then expect them not to break down. Deferred maintenance does not defer the problems – it simply makes them more expensive to fix when they do emerge. As the famous Midas Muffler commercial says, "You can pay me now, or you can pay me later." PM is the best way to catch such problems early.

PM is a high priority for any fleet of any kind. In the fire/EMS business, PM is doubly important given that it is not possible to put out fires, rescue people, and bring sick and injured people to a hospital without functioning emergency vehicles. Ambulances and fire apparatus are very expensive. Maintaining them rather than repairing them simply makes sense.

National Fire Protection Association (NFPA) Standard 1915 (Standard for Fire Apparatus Preventative Maintenance Program) addresses the minimum expectations for a comprehensive PM program. The benefits of implementing a PM program in compliance with NFPA 1915 are many. First, maintaining a vehicle is less expensive than repairing it. Second, vehicles which undergo PM are more likely to have a longer lifespan. Third, PM reduces time that a vehicle is unavailable for use in the community by reducing the chances of needing length repairs. Finally, demonstrating adherence to an NFPA 1915-compliant PM program reduces the chance of a maintenance-related untoward event and possible resulting lawsuits.

5.3.1.2 *Preventative Maintenance in FEMS*

Unfortunately, there is no semblance of a PM program in place at FEMS. For the most part, apparatus issues are addressed only after a failure – not in a proactive manner. This practice is not in line with industry standards, and it fails to meet the "common sense" test. Almost any car owner knows to replace brake pads *before* damage to the rotors occurs. Doing this means that only the pads need to be replaced – not the entire braking system.

The existing "PM program" consists of a single mechanic who travels from station to station, changing oil and filters, and assessing each vehicle to spot any pending major problems. Virtually none of the persons whom we interviewed felt that the services the roving mechanic provides are true a PM. Rather, they felt the roving mechanic performs a "mini-PM," which does not in any meaningful way adequately address the complex needs of a comprehensive PM program. Performing a real PM on a piece of fire apparatus can take as long as a week.

5.3.1.3 *Issues in Implementing a PM Program at FEMS*

In order to have a working PM program, a viable Ready Reserve fleet *must* exist for all vehicle types. This is *vital* to the implementation of a comprehensive PM program because a PM program must be user-friendly for firefighters in the field. Extended change-over processes (see Section 5.3.5) will set the PM program up for failure. The PM regimen must be strictly followed, and this is less likely to happen if it creates significant disruption to the end users.

The lack of adequate Shop floor space will be a major hurdle to overcome in establishing a PM program. A large portion of the service area needs to be *dedicated* to PM. According to Chatham Consulting, Inc., a fleet services management consulting firm, approximately one-third of the work bays in a shop should be dedicated to PM.[46] This amount of space is simply not

[46] Chatham Consulting, Inc., "Preliminary Final Report on Fleet Maintenance Facility Planning and Consolidation Evaluation for City of Rochester, Minnesota," November 2007, p. 22.

available in the current facility, given its current configuration and the massive amount of repair work in progress.

Staffing will be another major hurdle in the development of a proper PM program. Effective fleet maintenance depends upon an effective PM program, and an effective PM program should have mechanics splitting their time nearly equally between repairs and PM. With current staffing levels, the Shop is barely able to effect repairs. Implementing a proper PM program will, initially, increase the workload. Once the benefits of the PM program begin to accrue and the fleet is gradually replaced, however, the demand for repairs should decrease the workload. This argues for the temporary increase in mechanic staffing that is discussed in Section 5.2.2.

5.3.1.4 *Summary of Findings*

70. The absence of a PM program is a *severe* detriment to the FEMS fleet. PM saves money, keeps apparatus in service in the community more, and ensures lengthens the expected service life of apparatus.
71. The mobile servicing of apparatus currently being performed should not be confused with, nor should it take the place of, a real PM program.
72. Having a viable Ready Reserve fleet is a key factor in the success of a PM program.

5.3.1.5 *Recommendations*

80. Implementation of a comprehensive PM program in accordance with NFPA 1915 ***must*** be made a ***top*** priority. This point cannot be overstressed.
81. FEMS policy should ensure that apparatus is taken to the Shop for PM when it is scheduled, without fail.

5.3.2 Best Practices

Based on the Project Team's observation of operational processes in place and engrained within the operational and management culture at FEMS, a number of process issues permeate the system and hamper everyday practices. The following section presents a number of fleet "best practices" that could be implemented within the AD to improve operations. Some of the best practices describe below have simply been accepted as industry standard practices, while others are fairly cutting edge. We recommend that FEMS give serious consideration to adopting all of these practices as a way of addressing findings and shortcomings described in this report. APPENDIX I provides a suggested timeline for implementation of these best practices.

5.3.2.1 *Preventative Maintenance*

As fully discussed in Section 5.3.1, a strong PM program is a best practice and integral to the sound fleet operation of any fire department. PM is, at its core, a universally accepted industry standard which is embodied in both NFPA 1915 and private sector fleet operations. Any fleet management system that does not embrace and incorporate PM into its core mission is sorely

lacking in best practices processes. Of all the best practices cited herein, the immediate establishment of a comprehensive, dedicated, regularly scheduled, and assiduously adhered to PM program is without question the most critical best practice that FEMS needs to adopt.

In general, best-practice fleet maintenance shops do two types of PM: an annual, bumper-to-bumper PM, and a more frequent, lower-order PM (essentially an oil change and quick check-up) which based on mileage (which varies by vehicle class and assignment) or engine hours (usually about 250 engine hours).

5.3.2.2 *Strict Timekeeping*

Every well-managed, smoothly running shop is strict about its mechanics reporting their time assiduously. Mechanics need to clock in and clock out of vehicles as soon as possible because accurate timekeeping is *essential* to understanding the labor costs of maintaining a given vehicle. For example, in the MPD Shop, mechanics will clock into one vehicle, initiate an oil change by draining the oil from the vehicle, clock out of the vehicle and into another vehicle to conduct work on the other vehicle while the oil is draining from the first. When the oil is finished draining, the mechanic will clock out of the second vehicle and back into the first to continue needed work on that vehicle. In this manner, mechanics maximize their productivity while ensuring that FASTER has a much more accurate accounting of the actual time spent on each vehicle. This yields much more useful management information about how productive each mechanic is as well as what it costs to maintain each vehicle.

In current practice in the FEMS Shop, mechanics routinely stay logged into vehicles while they are working on other vehicles, taking breaks, etc. or do not log into vehicles at all.[47] This renders the data in FASTER virtually useless for managing Shop operations or the overall fleet. For example, as was noted earlier, it is not possible for us to calculate the Total Cost of Ownership of any vehicle in the FEMS fleet because required data have not been captured in FASTER.

The AD should issue and strictly enforce a policy on timekeeping. FASTER should be configured to capture time for a range of activities so that the AD leadership can better manage personnel and make more informed decisions about vehicle maintenance and replacement.

5.3.2.3 *Key Performance Indicators*

Performance metrics, or key performance indicators (KPIs), are used in virtually every field of endeavor. Best-practice organizations of all types have KPIs that are widely understood and disseminated throughout the enterprise. These organizations use management data, in conjunction with other management tools, to monitor their productivity and keep the outcomes of their processes on target.

[47] See the earlier discussion on this in Section 5.2.2.1.

Some typical management metrics routinely evaluated in effective fleet operations are illustrated in Table 34, which was abstracted rom FASTER data. As can plainly be seen, FEMS falls far short of industry targets for each of these important metrics.

Table 34. Typical Fleet Industry Key Performance Indicators

PERFORMANCE MEASURE	DESCRIPTION	INDUSTRY TARGET	FEMS COMPLIANCE
Fleet Availability Rate	The degree to which the fleet service provider is able to ensure the regular availability of fleet units to their user departments. Availability rates should be highest for mission-critical fleet units	95%	70%-86%
PM Program Compliance Rate	Measures the number of PMs performed on the date scheduled. A low compliance rate indicates that PMs are not being performed regularly. A high PM compliance rate is a basic building block for an effective maintenance and repair program.	95% on-time	8% on time >80% showing as Past Due
Scheduled Repair Rate	Measures the portion of all repairs identified and conducted in a controlled, planned manner. The combined purpose of the PM program, operator inspections, and service writing is to identify and take care of problems in a planned, scheduled manner so they do not result in unscheduled and costly breakdowns	50 to 66%	22%
Road Call/Tow Rate	Measures the percentage of all repairs conducted on broken-down or towed vehicles that cannot be driven to the shop. In combination with scheduled service rate, it provides an indication of PM program effectiveness.	2%	8%
Come-back Rate	Measures the percentage of time a customer returns a vehicle or piece of equipment back to the shop for the same problem within a specified period of time. It is a measure of service quality that reflects the accuracy of service writing and diagnostic activities as well as repair quality	1%	20%

In FEMS, examples of shortcomings in the collection and use of management data include inconsistent data capture practices, limited data validation and accuracy verification processes, poor usage of reports to monitor activity or to enable informed management decisions, and a lack of KPIs to evaluate, measure, and assess the operational effectiveness of the organization.

The AD needs to develop KPIs which address its need to manage its operations. These KPIs should form the core of daily, weekly, and monthly reports which show how the AD is meeting its performance objectives and how individuals within the AD are contributing to that overall mission. By sharing these metrics transparently, everyone within the AD will have a common incentive to keep their individual and collective performance at expected levels. AD and FEMS leadership should review relevant KPIs daily so they can stay on top of managing the fleet.

In addition to the KPIs described in Table 34, which are system-level KPIs, the AD needs to collect, track, and communicate some basic KPIs at the level of individual mechanics (see Section 5.2.3). These individual-level KPIs can be used by first- and second-level supervisors to

gauge how each mechanic is doing relative to his/her peers. Examples of individual KPIs include measures of how many "come-back" repairs occur within 30 days on a given mechanic's work, and through-put expectations in terms of direct labor, indirect labor, and non-logged time.

5.3.2.4 *Outsourcing Light-Duty Vehicles*

Best-practice fire department fleet maintenance facilities focus exclusively on heavy-duty apparatus. Light- and medium-duty vehicles – including cars, vans, and most SUVs – are outsourced to standard automotive repair facilities. Doing this allow fire service mechanics with specialized training and experience to focus their efforts and training on diesel engines and complex fire apparatus rather than dealing with problems that virtually any mechanic should be able to address.

5.3.2.5 *Outsourcing Towing*

When a vehicle breaks down in the field and is unable to return to the shop under its own power, a mechanic is responsible for taking a tow truck out to retrieve the vehicle. This removes a mechanic from the Shop floor. Given that virtually any towing company with a heavy-duty wrecker could tow FEMS apparatus, it would be considered a best practice to keep a highly skilled heavy-duty mechanic focused on repairing and maintaining fire apparatus.

Towing should be outsourced to a firm capable of towing any vehicle in the fleet. DPW and several commercial towing companies in the immediate area have this capability. The broken-down apparatus can then be dropped off at the shop, and mechanics would not have to stop working on other vehicles.

Reasonable performance standards should be embedded in any towing contract. For example, the contract (or service-level agreement) should ensure that an appropriate towing vehicle will arrive on the scene within one hour for 90% of the requests for service and within two hours for all requests for service, irrespective of the time of day that the towing request is made.

5.3.2.6 *Outsourcing Parts Supply Operation*

As discussed in Section 5.2.5.2, the BFD contracts out the parts department of its shop. This is a best practice that offers FEMS several advantages. First, it will lower inventory carry costs for FEMS. Parts would not be billed to FEMS until they were used, although they would be available for use because the availability of parts would be contractually guaranteed by the vendor. Second, having a vendor would increase the accountability and cost recordkeeping for parts. At present, there is virtually no accountability for the use of any parts. This means that parts could – theoretically – be being diverted to personal use without much chance of detection. Furthermore, since the costs of consumed parts are not being assigned consistently or accurately in FASTER to vehicles being maintained or repaired, it is virtually impossible to accurately gauge the true Total Cost of Ownership of any vehicle. This contributes to the inability to accurately determine vehicle lifecycle costs (see the earlier discussion of life cycle costs,

beginning on page 76). Finally, use of a parts vendor would bring a much-needed measure of professionalism and organization to a critical function within the Shop.

BFD's parts operation is responsible for ordering, stocking, and tracking everything the BFD Shop uses, including uniforms, jacks, lifts, and fluids. This lowers costs and enables the Department to more closely align inventories with operational needs.

The City of Boston also contracts out parts inventory management in its Police Department and its Central Fleet Maintenance operation. The City has had so much success with the outsourcing of parts services that it is considering consolidating all of its parts vendors under one contract for all fleet operations citywide.

The BFD is not the only example of a fire department outsourcing its parts operation. The City of Albuquerque Fire Department outsources its parts operation through a citywide parts outsourcing arrangement.

We believe that it would be beneficial for FEMS to outsource the parts function even if the decision is made to retain other Shop functions in-house.

5.3.2.7 *Service-Level Agreements*

A number of best-practice fire/EMS departments with which the Project Team is familiar employ SLAs with other agencies to have their fleet operations service the department's apparatus. Most of these fleet service operations are run as businesses, and the financial structures, management, and success of those operations are predicated on an industry-standard fleet management business model. Notable examples include:

- Boulder, CO, where fleet services are under the auspices of the City of Boulder Facilities and Asset Management Division.
- Linden, NJ, where all repairs including transmission and major engine repairs are done in-house, as part of the City of Linden's internal budget, at no cost to the fire department. Linden uses no outside contracting except for ladder testing.
- Portland, OR, where City Fleet, a division of the City of Portland's General Services Bureau, is responsible for the repair and maintenance of Portland Fire and Rescue's administrative and support vehicles. City government transferred this responsibility to City Fleet in an effort to consolidate and centralize the city's vehicle maintenance. Portland has a separate division apart from City Fleet for heavy apparatus repair. Although City Fleet is responsible for repair and maintenance of the support vehicles, all costs associated with repairs, maintenance, and replacement are paid for by Portland Fire and Rescue via an interagency agreement with City Fleet.

One thing all of these systems have in common is that they are interagency entities which use SLAs to provide services to the fire/EMS agency. The other common thread is that these practices are tied to sound business models which create financial accountability and efficient fleet management systems.

FEMS occasionally sends vehicles to other agencies (e.g., DPW) and is invoiced back for the cost of the work. FEMS also has had a short-term memorandum of understanding in place with D.C. Water to assist with occasional servicing needs.

As previously discussed, there are reasons to explore the possibility of outsourcing certain portions of the fleet. FEMS could explore formal SLAs with MPD, DPW, D.C. Water, the Washington Area Metropolitan Transportation Authority, and certain federal agencies, especially with respect to its light- and medium-duty fleet. An SLA with one or more of these agencies might prove to be an effective cost-saving measure that does not necessitate FEMS soliciting bids from external private sector vendors.

5.3.2.8 *ZONAR Handheld Vehicle Checkout System*

The ZONAR automated vehicle checkout system uses handheld radio-frequency identification (RFID) tag readers to ensure that vehicle operators conduct thorough vehicle checks. This system was developed for pre-trip inspections required in commercial fleet applications by the U.S. Department of Transportation, but it is beginning to be used in the fire and EMS setting. The BFD and Howard County (MD) Fire Department are both in the process of implementing the ZONAR system.

Implementation of the ZONAR system in FEMS would convert the missed opportunity created by skipping required morning checkouts into a means to funnel valuable information through FASTER to the AD. For example, if an apparatus operator identifies a deficiency during the daily checkout, the ZONAR handheld can automatically create a deficiency report and a work order in FASTER. In this manner, deficiencies can be systematically logged and prioritized for remediation. Finally, and most importantly, ZONAR ensures incontrovertible accountability for the performance of daily in-station vehicle inspections and the entry of work orders for the Shop.

5.3.2.9 *Station-based Deficiency Reporting*

Several jurisdictions reported using a computerized station-based deficiency reporting system to enable frontline personnel to submit timely deficiency reports in a systematic fashion. Some jurisdictions (e.g., Seattle and Montgomery County) had developed their reporting mechanisms using in-house IT capabilities, whereas others (e.g., Fairfax County and Boston) reported using COTS products.

A station-based reporting capability creates greater accountability because an auditable record of the submission is created and can be used for performance measurement purposes. Additionally,

such a capability allows fleet administrators to analyze submission information to identify trends and to create work efficiencies. For example, Montgomery County uses its reporting system to schedule mobile repairs and drop-offs of requisitioned disposable items such as vehicle fluids and replacement light bulbs.

5.3.2.10 *In-Station Maintenance and Repairs*

In best-practice fire departments, comprehensive PM programs begin in the fire stations. In agencies where the PM process works well, station personnel inspect apparatus on a daily basis and make minor repairs. In these jurisdictions, in-station maintenance by trained technicians is the first link in the PM chain.

5.3.2.11 *Synthetic Oil*

Synthetic motor oil is more expensive than conventional motor oil, but it costs more. Most fleets with which we are familiar have switched to synthetic motor oils because they perform (i.e., protect the engine) better and because the interval between changes can be extended. In the case of the FEMS fleet, the latter is a crucial benefit, as the lack of a viable PM program causes FEMS apparatus to go significantly longer in between oil changes than most other fleets would deem acceptable. Accordingly, using synthetic motor oils should be seen as a wise investment.

5.3.2.12 *Vehicle Fluid Testing*

MPD and BFD routinely send samples of motor vehicle fluids out for laboratory testing. Testing often identifies significant issues before major damage is done. For example, vehicle fluid testing can find small amounts of coolant in engine oil, allowing mechanics to fix a small leak before major damage is done. Testing transmission fluid for the presence of metals and moisture can identify a serious problem before the transmission fails.

5.3.2.13 *Customer Satisfaction Feedback Forms*

United Parcel Service (UPS) employs a best-practice customer satisfaction feedback system. When a UPS driver notes a deficiency during a pre- or post-trip inspection, a service request form is completed by the driver, and the vehicle is brought to a UPS shop for service. The next day, the form is left on the dashboard indicating exactly what the technician did with respect to the deficiencies noted by the driver. The driver then has the opportunity to provide feedback to the shop as to whether the repairs made were satisfactory.

MPD solicits feedback on the quality of its repairs and maintenance via a form that is left in the vehicle when it is returned to the unit to which it is assigned. These forms are filled out by the unit's Vehicle Maintenance Officer and returned to the MPD Shop. The forms provide valuable information to the MPD Fleet Manager and the Shop contract manager about the customer's satisfaction with the work. The feedback is used to improve operations and praiseworthy work is celebrated by posting the forms in a place where all can see them.

This is a simple and inexpensive technique that will build positive relations from the AD's end customers while also providing the AD with information it needs to keep its customers happy.

5.3.2.14 *Best Practices Workgroup*

The Department should convene a Best Practices Working Group (BPWG) which would meet on a regular (e.g., monthly) basis to identify, evaluate, and recommend for adoption best practices in fleet management from other jurisdictions. The value of a BPWG is that it would provide a continuous platform for identifying novel, successful approaches that could solve problems in the AD. Further, the Working Group would become the place where FEMS personnel could make suggestions for improvement and recommend best practices that they had heard about. Additionally, the BPWG could form collaborative relationships with people or groups in other jurisdictions that could prove beneficial over the long run.

The BPWG should have an e-mail address that is widely disseminated to facilitate input from FEMS members. It should meet on a regular basis in a consistent location. Consideration should be given to funding travel for BPWG members to visit jurisdictions with best practices that are promising for the District of Columbia.

5.3.2.15 *Summary of Findings*

73. There are numerous best practices that could be implemented in the AD and throughout FEMS that would improve the operations of the AD.

5.3.2.16 *Recommendations*

82. PM triggers should be expressed for each class of apparatus (and, in some cases, each vehicle model) and should reflect mileage, engine hours, age of the apparatus, etc., not just the number of days since the last PM.
83. The AD should issue and strictly enforce a policy on timekeeping. FASTER should be configured to capture time for a range of activities so that the AD leadership can better manage personnel and make more informed decisions about vehicle maintenance and replacement.
84. The AD needs to develop both system- and individual-level KPIs which are disseminated in daily, weekly, and monthly reports. AD and FEMS leadership should review relevant KPIs daily so they can stay on top of managing the fleet.
85. FEMS should explore the full range of possible outsourcing options, including contracting for all fleet management services or contracting for services for a portion of the AD workload, including towing, parts management, and/or light- and medium-duty apparatus. Establishment of SLAs with partner agencies should also be considered.

86. FEMS should implement a ZONAR pilot program in one or two stations to test the utility of the system to improve vehicle checkout accountability and deficiency logging/work order creation (see Section 6.1).
87. The AD should implement the FASTER Service Center or some other means to permit in-station reporting of deficiencies (see Section 6.2).
88. FEMS should permit trained technicians to effect certain authorized maintenance and repairs in stations (see Section 6.3).
89. The AD should use synthetic oil in all apparatus, especially since the time between oil changes can be so great at present.
90. The AD should regularly test vehicle fluids to identify contaminants that are indicators of pending engine problems.
91. The AD should implement a system to ensure that end users can provide feedback on the quality of services delivered in connection with maintenance and requested repairs.
92. The AD should implement a BPWG to identify, evaluate, and implement novel best practices from other jurisdictions.

5.3.3 Parts Operation

The inventory, or lack thereof, of parts immediately available for use by mechanics slows the pace of work in the fleet repair facility. This is the result of several factors, including how the shop uses the FASTER system, the absence of a specialist overseeing the parts inventory, and lack of standardization across the fleet. Just-in-Time parts inventory has become the norm in many industries. After all- the fleet maintenance facility is (or should be) in the business of maintaining and repairing apparatus, not in stocking massive amounts of parts. Still, parts necessary to affect repairs must be readily available to mechanics so that they may remain as productive as possible.

The FASTER system is capable of being configured to be much more useful in terms of inventory tracking. An effective parts inventory system should track the use of parts in each and every job. Pre-set minimum stock levels should be set in place so that orders are automatically generated when levels drop to a pre-determined level. In such a system, mechanics will more often find the part they need in stock – as long as everyone uses the system properly.

As discussed in Section 5.2.5.2, we believe that the parts operation should be outsourced. If the decision is made to keep the parts function in hours, then the Shop needs a parts inventory specialist. A mechanic, who graciously agreed to take on the role after the untimely death of the facility's previous parts specialist, currently holds the position. He is performing to the best of his abilities, but he is also being asked to handle several other roles within the facility – handling parts, interfacing with vendors, serving as a *de facto* foreman, and occasionally fixing fire apparatus. The parts specialist position should be filled with a parts professional.

The parts specialist has two issues to address as soon as possible. First, there is no computerized inventory, which means that the stock on hand can be both too large and too small. It is too large because FEMS must carry the cost of the inventory (currently estimated to be more than $1 million in value). It is too small because ineffective parts accounting means that the Shop often does not have needed parts on hand, even when the need for such parts would be anticipated were a computerized ordering system in place. The second issue that the parts specialist must contend with is the lack of standardization across the fleet. This factor is out of the control of the parts specialist, but he or she will still have to provide parts for working on apparatus from many different manufacturers.

Lack of availability in the parts operation manifests itself in several ways. It reduces the productivity of the mechanics, increases the time needed to get a vehicle back in service, and results in parts disappearing from other vehicles.[48]

5.3.3.1 *Summary of Findings*

74. Management of the parts inventory is poor.

5.3.3.2 *Recommendations*

93. Hire a parts inventory specialist as soon as possible, if it is decided not to contract out the parts function.

5.3.4 Small Tools Repair

Small tools refer to fire department tools that have small engines (e.g., circular saws, chain saws, and generators), hose and truck company appliances (e.g., nozzles and couplings), hand lights, and ground ladders. In an organization the size of FEMS there are literally hundreds of these essential tools. Even though they are not vehicles, these tools (especially those with engines) should be considered as much a part of the fleet management system as the rolling stock.

The AD Small Tools Section is located at the Shop and is currently "staffed" with a full-time frontline firefighter who is detailed once a month from his normal assignment to be the small tools repair mechanic for half of his 24-hour shift. During this 12-hour period, he repairs small tools, appliances, and ground ladders for all of FEMS. In the past, this firefighter supplemented the monthly schedule by working overtime at junctures when the workload in the shop was particularly heavy. Overtime has also been required to backfill his position during the half of his 24-hour shift when detailed. The Small Tools Section has not had dedicated staff for at least 12 years, and current staff have not received formal mechanical training but instead have had to rely on on-the-job training.

[48] The project team heard numerous tales of an otherwise-fine vehicle being taken to the Shop for a small repair, and while awaiting delivery of needed parts, other components being stripped from the unit to place different vehicles back in service. Then, even after the originally ordered parts arrived, the first unit could not be placed back in service because of the now-missing pieces.

The current situation has created a significant backlog in small tools repairs and the irregular hours makes it difficult for current staff to catch up. During each monthly 12-hours shift, the current repairman is able to repair an average of two to three small tool units. Some small too repairs are also performed on the main repair floor, because it is not efficient for mechanics working on major apparatus repairs to perform this type of work. Some repairs are outsourced, but how many is unknown because none of those repairs are tracked. Those repairs are expensive ($60 to $80/hour) and are often unreliable.

The current repairman's duties include inventorying small tool parts and assessing the need for parts to complete certain repairs that require ordering. He does not use FASTER to inventory or order parts, nor does he use it to track his hours working on small tools, work order requests, or the disposition of small tools or appliances that are repaired or placed out of service permanently. He has nominal supervision from the Administrative Captain at the Shop.

The small tool shop also has the responsibility of repairing ground ladders. An incident 4 years ago exemplifies the backlog of repairs. During a training exercise a 45-foot extension ladder pulley failed, the fly section of the ladder came down and broke a firefighter's ankle. The small tools repairman was assigned to replace every pulley in the fleet. The subsequent repairs took 2 years to complete because of his once-a-month schedule, cuts in overtime, and the enormity of the undertaking. Similarly, there is currently a project to replace all worn or dry-rotted ground ladder halyards. At the current pace, this project will take an inordinate amount of time to complete. Further, once the ladder repairs have been completed those ladders have to be re-tested, so they often sit in the Shop repaired but untested and unusable for months at a time.

The Small Tools Section is also responsible for engine company pump testing which, according to industry standards, is supposed to be performed once a year. No pump testing has been performed on any FEMS engine company in the last 3 years.

All of these duties are performed, on average, once a month during a 12-hour shift with very little continuity in repairs, regard for safety, and or adherence to required testing regimens.

5.3.4.1 *Small Engine Maintenance*

EPA regulations requiring the addition of ethanol to gasoline have had an impact on small engines, including those found on chainsaws and other tools carried on fire apparatus. Ethanol can have a detrimental effect on small engines, particularly if the fuel is more than one month old. Ethanol attracts water as fuel ages, and this water can do significant harm. Removing ethanol from fuel is hardly an option, but using an additive that helps to reduce moisture and prevents varnish buildup is helpful in extending the life of small engines. As with a PM program for apparatus, preventing damage from moist fuel is easier than repairing the damage.

5.3.4.2 *Summary of Findings*

75. FEMS does not have sufficient personnel for the effective and efficient operation of a small tools repair shop for a fire/EMS department of this size, based on the workload and workforce currently in place.
76. Crucial small tool repairs and critical pump testing requirements are languishing behind schedule due to a lack of a dedicated full-time (or even part-time repair) program and repair person.
77. The current schedule of small tool repairs and the lack of a dedicated maintenance and repair program has created and perpetuated a critical and inefficient backlog of small tool repairs and out-of-service equipment.
78. Ground ladder safety has been compromised by the lack of and commitment to a dedicated repair and maintenance program in the Small Tools Section.
79. Critical pump testing has not occurred for 3 years.
80. FEMS uses gasoline with ethanol in small tools, which can damage small engines.

5.3.4.3 *Recommendations*

94. FEMS should obtain a full-time small tools repair technician to address the crucial backlog of tool repairs and pump and ladder testing. If the position is to be filled on a part-time basis, it should be *substantially* more than 12 hours per month. This position could be an outsourced FTE which is part of an overall contract with a Shop vendor.
95. FEMS should immediately reinstate and adhere to a pump testing program which meets the requirements of NFPA 1911 (Standard for the Inspection, Maintenance, Testing, and Retirement of In-service Automotive Fire Apparatus).
96. FEMS should immediately reinstate and adhere to a ground ladder inspection and testing program which meets the requirements of NFPA 1932 (Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders).
97. FEMS should use a fuel treatment designed to minimize damage to small tool engines from ethanol in gasoline.

5.3.5 Reserve Apparatus/Change-Overs

In most fire/EMS departments, reserve apparatus are not normally fully stocked and ready to go. This is a cost-savings measure necessitated by the expense of having duplicate sets of equipment. Given its high call volume and the service delivery expectations of the public, FEMS opts to keep a portion of its reserve fleet fully stocked (i.e., as "ready reserves").[49] When the supply of ready reserves is depleted, then frontline units that go out of service must be replaced from the

[49] This is a wise strategy that is employed by other high-volume fire/EMS agencies as well.

reserve fleet. This necessitates crews performing a "change-over" (i.e., the process of pulling equipment off a piece of apparatus and using it to restock another).

Change-overs are laborious, but more importantly, they keep apparatus out of service and unable to serve neighborhoods. Conducting a change-over can take as much as 2 hours (but generally no less than an hour) for an engine company. The process of unracking and re-racking 2,000 feet of fire hose is both tiring and time-consuming (it can easily take upwards of an hour just to change over the hose). Change-over times for truck companies and squads can be even longer because of the large amount of specialized equipment these units carry. Change-over times for ambulances are generally an hour or more.

Minimizing the number of change-overs and the amount of time a change-over takes are good ways to keep units in service in the community. The Project Team observed several change-overs in progress during our station visits. On more than one occasion, the change-over we saw was the second *or third* change-over of the day for that unit. EMS crews reportedly perform as many as two to four change-overs per day!

Figure 37. Changing Over Apparatus at Engine 31's Quarters

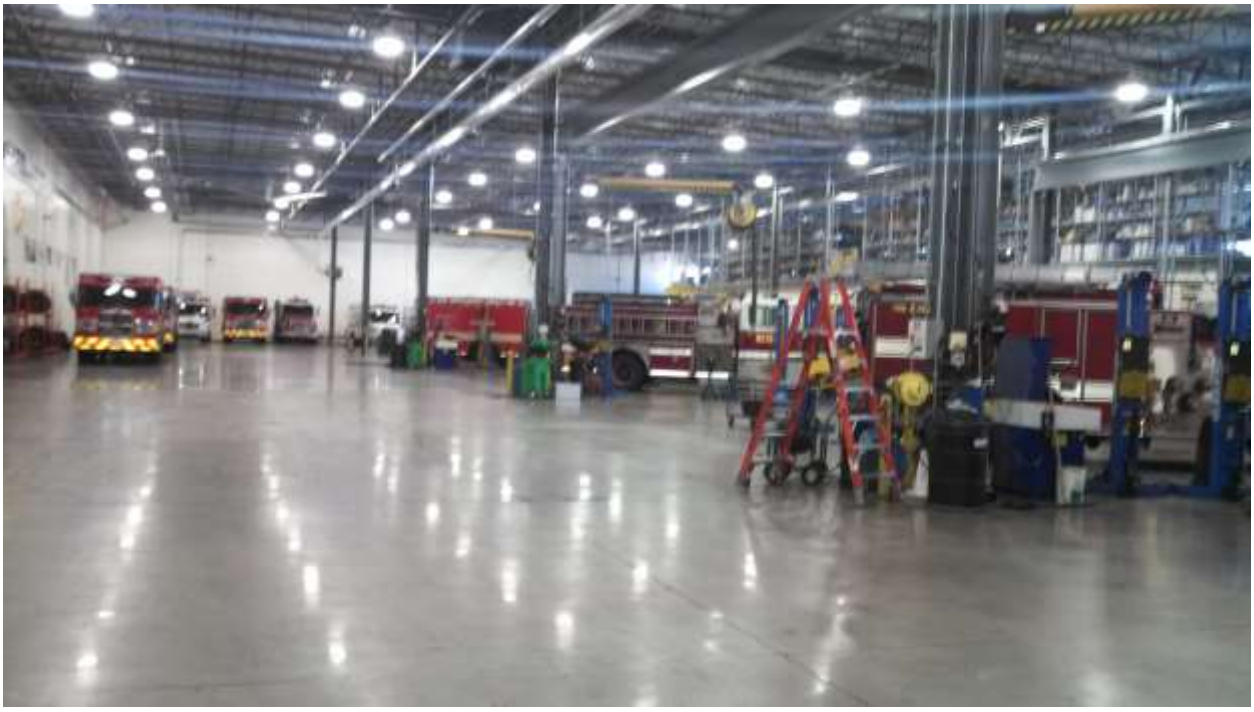
Obviously, some number of change-overs is unavoidable, but to the extent that a change-over must be performed, there are ways to ensure that they are as speedy as possible.

First, keep low-cost items on reserve apparatus even if the apparatus is not technically a Ready Reserve unit. Even high-cost items can be a candidate for keeping on reserve apparatus. Given the length of time it takes to swap out fire hose on engine companies, the BFD went so far as to

purchase extra hose for its reserve engines so that change-over time could be kept to an absolute minimum. According to the BFD Deputy Commissioner for Finance and Administration, the cost of the extra hose needed was viewed as an investment in keeping fire suppression resources more available to the community.

Also, change-overs should be conducted indoors, whenever possible, as this makes change-overs faster and more comfortable for the people performing them.[50] Figure 38 is an example of a shop facility with ample room to perform simultaneous change-overs of multiple apparatus in all types of weather. Article XX, Section 24 prohibits units from being changed over at the Shop unless instructed to do so by a Shop foreman. This prohibition is clearly warranted given the extremely crowded conditions at the Shop. This prohibition should, however, be lifted if a new Shop with adequate floor space is constructed.

Figure 38. Sufficient Floor Space to Perform Change-overs Indoors



Finally, collocating supplies for reserve apparatus – especially reserve EMS apparatus – with the Shop would enable rapid replacement of missing items without necessitating a cross-town trip to the Logistics facility on V Street, NE.

[50] Changing over apparatus in the heat of a Washington, DC summer is unpleasant and tiring – as is changing over apparatus in the rain, snow, or extreme cold.

5.3.5.1 *Logistics Facilities for Changing Over Reserve Apparatus*

In current practice, Ready Reserve/EMOP and recently repaired EMS units are restocked by a special team at the Logistics Division facility on V Street, NE. This process is a laudable effort to keep EMS personnel in service as much as possible by reducing the change-over time associated with putting EMS units back in service. This process could, however, be improved.

Under the present process, when the Shop releases an EMS unit, that vehicle is driven to Logistics where it is restocked and made ready for service. The vehicle is then driven back to the Shop where it is taken by the next EMS crew needing a vehicle ready for service. The total roundtrip is approximately 11 miles, about half of which is subject to moderate to severe traffic.

A "mini-Logistics" facility co-located with the Shop would reduce the amount of driving between the Shop and Logistics, and it would return units to service more quickly. Given the paucity of space at the Shop, this idea would probably need to be deferred until a new vehicle maintenance facility is constructed; however, if the Department can identify suitable space at the Shop, consideration should be given to implementing such a facility there. One possible option is the use of one of the shipping containers in the Shop parking lot for this purpose; however, the Project Team realizes that the use of one of the containers may be impractical. With a mini-Logistics facility at the Shop, only one roundtrip between the Shop and Logistics would be needed each day – a run to restock the mini-Logistics facility. This would save time, fuel, and wear-and-tear on the vehicles, and EMS units would be returned to service faster.

5.3.5.2 *Summary of Findings*

81. Change-overs are laborious, tiring, and time-consuming. During change-overs units are unavailable in the communities which they serve.
82. FEMS personnel are called upon to change-over units on a frequent basis – sometimes multiple times per day.
83. Vehicles make unnecessary and long trips to the Logistics facility on V Street, NE to be restocked.

5.3.5.3 *Recommendations*

98. FEMS should seek ways to keep reserve units partially stocked with low-cost equipment and should consider buying extra hose to keep the hosebeds of engine companies from having to be restocked.
99. The AD should lift the prohibition of conducting change-overs indoors if a new Shop with a suitable amount of space can be constructed.
100. A "mini-Logistics" facility should be co-located with the Shop so that vehicles can be returned to service fully stocked without having to leave the Shop.

5.3.6 Quality Control

Quality Control in any organization is the post hoc review of work produced to determine whether it meets predetermined, objective quality standards. As such, QC is a vital component of any maintenance and repair facility. Unless QC is done, it is not possible to say whether the work a mechanic or contractor performs is satisfactory.

Failure to perform QC can have disastrous results. In 2009, the Boston Fire Department learned the hard way about the need to perform a QC check. A fire lieutenant was killed when BFD Ladder 26 lost its brakes on a hill and crashed into a building. An internal accident inquiry panel found that a brake repair performed by a contract vendor had not been performed properly. The work never underwent a QC check which might have caught the deficiency.

There is no appreciable program within the AD to perform QC on either the work of the Shop or outside vendors. The lack of QC is reflected in the amount of rework that is done on apparatus (see Section 4.1.2 and, specifically, Figure 19) and the impressions of virtually every firefighter with whom the Project Team spoke. Furthermore, as Table 34 (in Section 5.3.2.3) indicates, FEMS has a "come-back" rate nearly 20 times the industry standard.

One issue which numerous people complained about was being directed to go to the Shop to pick up apparatus only to find that the repairs were not completed satisfactorily or that not all of the items on a work order were addressed.[51] This wastes crews' time and unnecessarily keeps apparatus out of service in the communities they protect. It adds to a level of frustration with the Shop and perpetuates the image most firefighters have of Shop personnel as incompetent and/or disinterested. QC checks are an essential and effective means to address this problem.

Every repair and PM activity should receive a QC check. This is both a safety and a cost concern. It is far better to catch inadequate work before the vehicle leaves a repair facility than afterwards. Moreover, in terms of mechanic accountability and performance, the quality of the work done is as important as its timeliness.

Work that is done by vendors must also receive a QC check at the time of pickup. It is a waste of time and fuel to drive apparatus back from a vendor only to determine that the repair was not acceptable and have to bring the apparatus back to the vendor. This means that personnel sent to retrieve apparatus from a vendor need to have the background and training to be able to perform QC on the work that was outsourced.

[51] For example, the tractor position indicator on Truck 7 has been missing for several years. Personnel assigned to Truck 7 have repeatedly noted this deficiency, yet it persists. The tractor position indicator is a critical safety device designed to ensure that the cab of the truck is in a safe position relative to the trailer before the aerial ladder is elevated. Raising the ladder with the truck incorrectly positioned could result in the entire truck rolling over. That this critical deficiency has not been corrected is a direct result of the lack of QC practices at the Shop. Another example is that the oil cap on Water Supply 56 has reportedly been missing for 2 years, and a shop rag has been shoved into the opening in its place. Although the oil cap is not a critical safety, the inability of the Shop to address this issue makes the Shop look bad in the eyes of the firefighters who have notified the Shop of the deficiency.

5.3.6.1 *Summary of Findings*

84. There is no appreciable QC program in place within the AD.
85. There is a considerable amount of rework done on repairs made on FEMS apparatus – far in excess of industry norms.

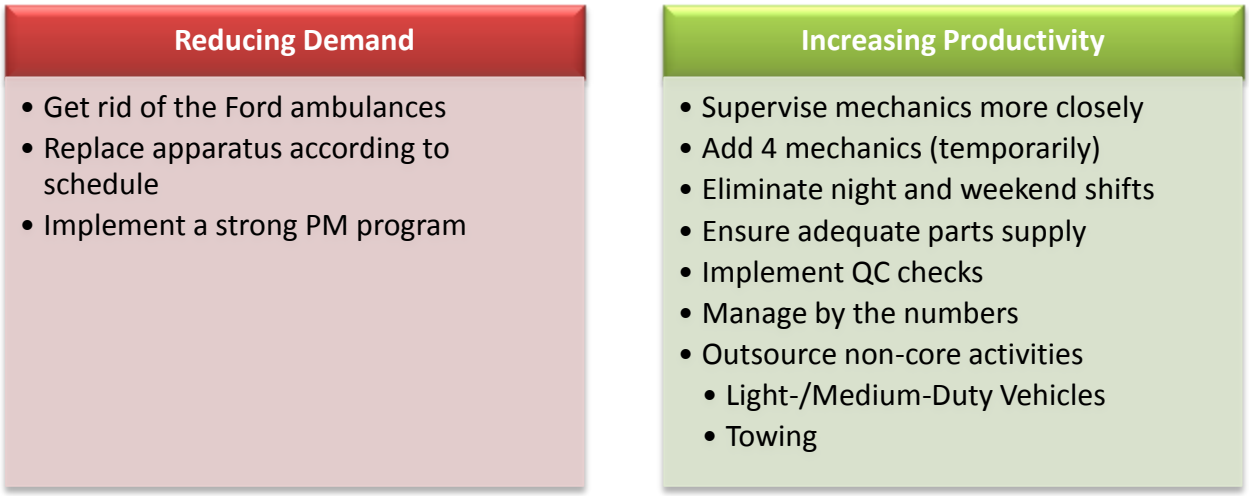
5.3.6.2 *Recommendations*

101. A qualified QC Specialist should be hired by FEMS (see Section 5.2.5). If the decision is made to contract out Shop operations, then this person should not be a contractor (or, at the very least, should not be part of an overall Shop management contract), as one of the key responsibilities of this individual will be to examine the quality of work performed by the contractor's mechanics.
102. Ensure every PM and repair undergoes a QC check. Work that is unsatisfactory must be corrected before the work order is closed and the vehicle leaves the facility.
103. Personnel dispatched to Shop vendors to retrieve vehicles that are "ready" must be able to perform QC checks at the vendors' facilities so that inadequate repairs are identified as such before the vehicle is accepted by FEMS.
104. QC metrics should be collected and analyzed for every mechanic. This will permit the AD leadership to ensure that mechanics are meeting quality expectations. It will also permit the identification of trends that could necessitate remedial training or other appropriate mitigation measures.
105. QC metrics should be collected and analyzed for each vehicle. This will aid the AD leadership in evaluating the continued roadworthiness of the apparatus and whether apparatus has outlived its useful service life.

5.3.7 Backlog Reduction Approach

The Shop cannot keep pace with the demand for its services. The most obvious manifestation of this problem is a seemingly intractable backlog of units awaiting repairs (and, occasionally, PM). Resolving this backlog will require an ambitious, coordinated program to reduce demand and increase productivity. This approach is summarized in Figure 39.

Figure 39. Backlog Reduction Approach



5.3.7.1 *Demand Reduction Strategies*

Replace Ford ambulances currently in service – As discussed in Section 4.1.2.5.1, the current Ford ambulances in the fleet exact a devastating toll on the ability of the Shop to maintain and repair other vehicles in the fleet. The current Ford ambulances break down incessantly, and they are difficult to work on. The Ford ambulances currently in the fleet collectively account for almost the same number of work hours logged as do engines, trucks, and squads *combined*. Because of the importance FEMS places on getting EMS transport units back in service as soon as possible (necessitated by the huge portion of the overall FEMS call volume which EMS represents), ambulances receive a higher priority for repair than do other types of apparatus. This means that maintenance and repairs on engines, trucks, and squads frequently does not get done in a timely manner.

The current Ford ambulances in service should be removed from the fleet as soon as possible and be replaced with more reliable vehicles, as this reduce demand in the Shop and free up mechanics to address backlogged maintenance and repairs. The recent acquisition of 30 ambulances will assist in this respect; however, we caution against the temptation to replace too much of the fleet at the same time. The trick will be to get the current Ford ambulances out of the fleet as quickly as possible without creating a need to replace a large number of ambulances at the same time when they finish reserve service 7 years hence.

Replace apparatus according to schedule – If FEMS were to do *nothing* but eliminate the current Ford ambulances from the fleet, the present backlog would be greatly reduced. Of course, this is not the only measure FEMS should undertake to reduce the backlog. FEMS should adopt a multi-pronged approach to demand reduction. In addition to ridding the fleet of the Ford ambulances, FEMS should ensure that it replaces apparatus (all classes of apparatus) on a consistent basis, according to its preferred replacement schedule. If apparatus is left in frontline status for too long, then it is more prone to failure and less useful as future reserve

apparatus. Fleet replacement coupled with a strong PM program will reduce demand on the Shop.

Implement a strong PM program – Another critical element of the demand reduction strategy is the implementation of a dedicated PM program. As we have repeatedly stated throughout this report, PM is at the core of keeping any fleet running smoothly. Although it seems counterintuitive to take resources away from making repairs and dedicate them to performing PM when a backlog of repairs exists, we believe that this can occur and will be successful in the long run. Preventing more breakdowns through PM will effectively mitigate future demand for repairs.

5.3.7.2 *Productivity Improvement Strategies*

Supervise mechanics more closely – As discussed in Section 5.2.3, mechanics need to be more closely supervised and held accountable using a combination of performance expectations and strict timekeeping. This is one of the primary roles of the foremen. AD leadership should, in turn, closely supervise the foremen, ensuring that they are accountable for the performance of their teams, collectively, and the mechanics they supervise, individually.

Eliminate night and weekend shifts – Eliminating the night and weekend shifts and reassigning the personnel from those shifts to the two remaining shifts (the day and evening shifts) will result in higher productivity, as discussed in Section 5.2.4. The real benefits from such a move are that there would be two foremen and a greater number of mechanics on each shift. The decreased span of control will assist in ensuring that mechanics are more closely supervised, and the increase in the number of mechanics on duty at any given time will means jobs requiring more than one mechanic will able to be accomplished more easily.

Add four mechanics (temporarily) – Were the Shop being run in accordance with industry best practices, the Shop would not need more than the 15 mechanics currently employed there. At present, however, the Shop is performing sub-optimally. In recognition of this fact, the Project Team recommends that FEMS hire four more mechanics on a "temporary" basis to bring the total number of mechanics on the floor to 19. After the other recommendations in this report are implemented and the Shop has made demonstrated improvements in KPIs, the number of mechanics employed can be allowed to return to 15. It is important to understand that these four extra mechanics will assist with increasing productivity, but only to the extent that they are supervised and held accountable for the timeliness and quality of their work.

Ensure adequate parts supply – The Parts Specialist needs to proactively check scheduled maintenance and repair work to ensure that sufficient parts are on hand for anticipated needs. Foremen need to be monitoring the availability of parts that their mechanics need. When parts are not available, foremen need to be engaged with the Parts Specialist to determine why needed parts are unavailable and to resolve future inventory issues. Everyone needs to communicate

about parts supply so that the maintenance and repair schedule can be adjusted, if necessary, to avoid delays in taking on and completing certain types of servicing when parts are unavailable.

Implement QC checks – In addition to helping to improve mechanic accountability, checking the quality of completed work before apparatus is returned to service will reduce the amount of rework needed, resulting in savings in money, in-service time, and frustration with the Shop. Less rework will allow Shop personnel to be more productive, thus reducing the backlog.

Manage by the numbers – Better development and use of management data will enable the AD leadership them to spot trends and problems that lower the Shop's productivity and refine Shop operations to improve productivity. This will require that data being entered into FASTER is of higher quality. It will also require that FASTER be utilized to generate reports and information that the AD leadership then consults and utilizes on a daily basis.

Outsource non-core activities – Another way to improve productivity is to outsource non-core activities of the Shop, as discussed in Section 5.2.5. Letting Shop mechanics "stick to their knitting" will result in a closer alignment of the limited resources represented by heavy-duty equipment mechanics to the need for their specialized skills. Accordingly, careful consideration should be given to outsourcing *any task* that is not central to the mission of the Shop. If Shop personnel do not need to take time from maintenance and repairs to tow or jump start vehicles in the field, they can keep working on critical apparatus. Likewise, if they are not working on sedans, utility trucks, and ambulances, then they can instead be working on apparatus that cannot be serviced at a standard automotive repair facility.

5.4 Physical Infrastructure Issues

Good physical infrastructure underpins the ability of any fleet maintenance organization to conduct any repairs in a safe and efficient manner. A well-organized shop with sufficient space both to make and oversee repairs is absolutely essential for the AD.

The AD Shop on Half Street, SW was built in 1960. It has a working floor area of 28,230 square feet, which includes an area with a separate entrance on the west side of the building where ambulance PM is supposed to take place. There are three specialty shops adjacent to the south side of the main repair floor for the small tools, welding, and machinist shops. These specialty shops are actually well placed with respect to the main repair floor. There are also four additional work bays in the northwest portion of the Shop. These are designated for body work and paint jobs.

The Shop lacks good ventilation, and is dirty, dark, and extremely crowded. It is an uninviting and inhospitable place to work. It was not clear to the Project Team why anyone would want to work there.

Given the changes in the size of the fleet and the size of individual apparatus that compose the fleet since the Shop was built, the facility has outlived its useful life.

5.4.1 Layout and Floor Space

The physical layout of the Shop is inefficient. Although the main repair floor is large in comparison to that in a number of the comparison jurisdictions, any size advantage is entirely offset by the Shop's poor layout. There is insufficient floor space to easily and cleanly accommodate the large number of vehicles needing repairs. The roof of the main repair floor is low and some fleet vehicles can only enter the Shop through certain doors without striking overhead fixtures. Ceiling height severely hampers the ability of mechanics to raise aerial ladders or to lift equipment for maintenance.[52]

5.4.1.1 *Lack of Dedicated Floor Space for Preventative Maintenance*

When the Shop was originally constructed, there were two dedicated PM work bays, but due to the exigencies of making repairs, over the years those dedicated bays have become repair areas. This is one of the reasons (but certainly not the only reason) that there is no effective PM program within the AD.

5.4.1.2 *Insufficient Floor Space to Afford Sight Lines for Management*

The Shop is extremely crowded with apparatus (see Figure 40). Apparatus in for servicing is parked anywhere space will allow. This results in the loss of sightlines within the Shop. Clean sightlines are essential to enable foremen to see the activity of the mechanics on the floor.

Figure 40. Typical Apparatus Placement in the Shop

By contrast, the MPD and Montgomery County Fire-Rescue Shops offer good examples of facilities which afford foremen relatively clean sightlines (see Figure 41).

[52] Having high ceilings is essential for servicing fire apparatus because apparatus must often be lifted with the drivers' cab tilted, and aerial devices often need to be elevated for servicing or testing. A recent report written by the City of Albuquerque Office of Internal Audit surveyed nine jurisdictions and found ceiling heights in repair facilities for fire apparatus averaged more than 22 feet, with two shops having ceiling heights of greater than 30 feet.

Figure 41. Sightlines in the MPD and Montgomery County Fire-Rescue Shops

5.4.1.3 *Inadequate Parts Storage*

The parts storage area is crowded and poorly laid out. It reflects a lack of an organized system to track and maintain a proper inventory. The parts office is cramped, poorly organized, and not conducive or configured to facilitate dispensing parts or monitoring the inventory. Parts storage areas are wide open, allowing anyone to access inventory holdings. Parts are unsecured at night.

5.4.1.4 *Summary of Findings*

86. The repair facility is not adequate for working on modern fire apparatus.
87. There is no dedicated floor space for preventative maintenance.
88. The Shop is overcrowded with apparatus, and sightlines are virtually non-existent.
89. The low ceiling height impairs the ability to lift units for inspection/repair and to elevate aerial devices.

5.4.1.5 *Recommendations*

106. Replace the facility with a structure designed for current and future fire apparatus. This would require detailed space planning based on the acquisition schedule and projected increases in apparatus and should consider the need to move apparatus in and out of the facility on an ongoing basis and the frequency and types of repairs.
107. Dedicated PM bays should be viewed as an essential part of the design of a new shop facility. Given the recommended size and composition of the fleet, at least one bay for heavy-duty apparatus PM, two bays for ambulance PM, and one bay for light-duty PM should be included in the design (if the decision is made to retain the servicing of light-duty vehicles in the Shop).

5.4.2 Lifts

The facility is also lacking lifts and pits found in most modern shops.

Mobile lifts are the only equipment capable of lifting heavy apparatus. These systems are very effective and have many advantages over a fixed lift, including being portable, more easily

repaired, and easily relocated when not in use. Any service work that requires a wheel to be removed from the vehicle, however, cannot be accomplished with a mobile lift system in place as such systems lift the vehicle by the wheels. As a result, the units must be lowered onto portable jack stands. This is a time-consuming process, and it requires that the weight of the vehicle be transferred from the mobile lifts to the jack stands – a maneuver that can have disastrous consequences if not done correctly. A facility performing maintenance on a fleet with so many large vehicles should have at least one fixed lift capable of supporting the largest vehicle in the fleet without limiting access to the vehicle's wheels.

5.4.2.1 *Summary of Findings*

90. The lack of an in-ground lift adds to time needed to effect many repairs.
91. The lifts in the ambulance PM area (in the rear of the shop) are not powerful enough to life the new International Harvester ambulances.

5.4.2.2 *Recommendations*

108. Ensure that any new shop facility is equipped with at least one in-ground lift.
109. Procure mobile lifts that are sufficiently powerful to lift the International Harvester ambulances.

5.4.3 Storage Facilities for Apparatus Awaiting Service or Pick-up

There is inadequate interior storage space for vehicles awaiting service or pick-up, necessitating that vehicles be stored in the open and, frequently, on the street (although this practice has been greatly curtailed and is much improved). Much of this is due to the backlog of existing repair work and a seemingly endless stream of vehicles being added to the queue for new repairs. On any given day, there are as many as 15 to 20 ambulances (predominately Fords) sitting in the fenced-in lot on the north side of the Shop. Much of what amounts to the glut of vehicles outside the Shop is due to the lack of any usable storage space inside the Shop and a main repair floor which is constantly overflowing with vehicles in various states of disrepair.

The congestion in the parking lot and adjacent streets combine to make it hard to find apparatus at/around the Shop[53] and tricky and time-consuming to move apparatus when the vehicle is ready for or finished with servicing. The parking lot and main repair floor are reminiscent of a familiar children's puzzle (see Figure 42), which involves moving vehicles around in order to move a car from one side of a parking lot to the other. It is not possible to know how much time is lost during the average workday in trying to locate vehicles at the Shop for maintenance or in moving

[53] The Project Team witnessed this first-hand on several occasions when we needed to locate a vehicle at the Shop during our inventory. There is no system for designating where a vehicle is parked awaiting service or pick-up. Therefore, when one needs to be located, Shop personnel must walk around until they find the appropriate vehicle. Additionally, the lack of a centralized place to leave keys means that locating keys to move a vehicle can be a challenge. The Project Team had to wait on a number of occasions while missing keys were located.

vehicles around (as with the puzzle), but the Project Team felt that this represented a considerable amount of time over the course of an average work week.

Figure 42. Children's Parking Puzzle

5.4.4 Storage Facilities for Reserve Apparatus

All apparatus should be stored in a climate-controlled environment. This is particularly important for Ready Reserve apparatus, such as ambulances, that might be stocked with temperature-sensitive equipment and supplies. Currently, some non-frontline equipment is stored in fire stations and some at the Shop. Additional space should be identified for storage of the balance of the fleet. Continuing to store some pieces in fire stations is a good idea. For example, the Water Supply engines should be readily available for deployment and stored inside, especially in the winter months. Some Ready Reserve equipment may also be stored at stations, though some pieces of the Ready Reserve fleet should remain at the shop for immediate use by companies coming in to the Shop for PM. Reserve apparatus (i.e., apparatus that is stored without a full complement of equipment), can be stored at a separate facility.

One concern with storing apparatus at the Shop is the potential for the stored apparatus to interfere with repairs and maintenance. The Shop floor is laid out in such a manner that apparatus can easily get boxed in. Storing excess reserve apparatus at the Shop only exacerbates this situation. Realistically, only Ready Reserve apparatus needed to accommodate a PM program should be stored at the shop.

Equipment that does not stay at the shop or in a fire station should be kept in a facility similar to the warehouse behind Station 24. The amount of floor space required for the storage of reserve apparatus is estimated in Table 35.

Table 35. Reserve Vehicle Storage

	NUMBER OF RESERVE UNITS	NUMBER TO STORE IN STATIONS	NUMBER TO STORE AT SHOP	NUMBER FOR STORAGE	FLOOR SPACE (SQ.FT.)
Engines	26	18	3	5	2,100
Aerials	10	5	1	4	3,360
Squads	3	0	0	3	1,620
Ambulances	47	12	10	25	9,000
Buggies	8	0	2	6	1,800
Trailers	20	20	0	0	0
TOTAL					17,880

5.4.4.1 *Summary of Findings*

92. Based on the size of the reserve fleet, approximately 18,000 square feet of covered storage is needed to for reserve apparatus.

5.4.4.2 *Recommendations*

110. Procure – either through construction or leasing – approximately 18,000 of suitable, covered space in which to store reserve apparatus.

111. Store the minimum amount of Ready Reserve apparatus possible at the Shop.

5.5 Policies and Procedures Issues

5.5.1 Overview of Standard Operating Procedures for Fleet Management

During the discovery, data collection, and interview phases of the project, the Project Team requested a copy of all published policies and procedures which guide and direct fleet management, maintenance, and repair in the AD.

The request included documentation on policies and Standard Operating Procedures (SOPs) related to:

- General Fleet Management Procedures
- Operational Fleet Management Procedures
- Fleet Asset Management Procedures
- Risk Management Procedures
- Procedures for Legal Compliance and Compliance with Rules and Regulations

We were quickly informed that none existed, and that DPW's policies and procedures manual was being used as a guide and template for possible adoption at FEMS. In lieu of a specific policies and procedures document, the AD seems to loosely rely on FEMS Articles XIX, XX, and XXV as guiding documents. The problem is that these documents are directed solely at

FEMS uniformed personnel, and are used as a backdrop for the AD to support the fire department's mission for delivery of emergency services by keeping the fleet rolling. The AD does not have any fleet management policies which specifically govern the non-uniformed foreman, mechanics, ticket writers, dedicated PM schedules or procedures, and Shop operations. Additionally, there is no written mechanism within the organizational structure, procedurally or otherwise, which systematically addresses work that is in the process of being done or work that is to be done.

Without guidelines organizations flounder and do not function in a consistent and predictable manner, and it is very difficult to hold people accountable. This is a symptom of much that is wrong at the Shop. Simply put, policies and procedures address, organize and simplify fleet operations and hold everyone in the organization accountable. This is particularly critical with regard to PM, which is virtually non-existent. A dedicated, well-established, non-negotiable PM policy would create a mechanism/system that could not be veered away from and would systematize accountability in this all-important aspect of fleet operations.

Nothing within the realm of policies, procedures, or organizational guidelines exists. Having a set of well-written, well-planned, systematic, and structured performance guidelines and policies in the form of a SOP document or handbook is one of the most important keys to success for a fleet management organization. Mercury Associates indicates that this is accomplished in a number of ways:

- Monitoring the progress and, where necessary, expediting the completion of work. This includes protocols for passing work from one technician or shop to another, and/or from the shop to a vendor.
- Establishing strictly adhered to protocols and procedures for a Preventative Maintenance program for the entire fleet.
- Following up on repairs of which completion by a technician or vendor is excessively slow, and on parts for which delivery is overdue.
- Ensuring that appropriate controls over the services and costs provided by a vendor are in place. Such controls are particularly important as vehicles approach their planned replacement dates.
- Scheduling work into the shop in advance, in order to ensure the cost-effective utilization of in-house resources and to minimize maintenance and repair turn-around time and downtime.
- Performing minor repairs while the driver and his/her crew wait.
- Distributing work to technicians so as to promote high levels of productivity, efficiency, and effectiveness, and minimizing repair turn-around time by assigning work to a specific technician based on the skills needed to complete the job.

- Establishing priority systems for identifying vehicles that should be moved ahead in the repair queue based on their importance and/or the type of work involved.
- Assigning work to vendors, relied upon to help out for a variety of reasons, including managing in-house work backlogs, tooling, training, and staffing; accomplishing specialty repairs; and achieving a degree of flexibility (in terms of locations, hours of service, etc.) in the provision of services.
- Mechanic tools requirements and acquisition

It is imperative that the AD create and adopt an SOP with a set of policies, procedures and guidelines which address these serious issues. In a division which is so critical to the operations of the department and its emergency service delivery system, and is responsible for multi-million dollar equipment, it is truly shortsighted not to have such a policy and procedures in place. The SOPs need to comprehensively cover every aspect of fleet management operations. It will hold the entire organization accountable, and will be an important step in changing and improving a stagnant organizational culture.

Since no appreciable SOPs exist for the AD, policies and procedures must be developed from scratch – but not in a vacuum. These SOPs should specifically address how the Shop will be managed, maintained, and operated on a daily basis. A wide cross-section of internal stakeholders should collaborate to develop these SOPs. The SOPs should include, but not be limited to, specific policies directed at foreman and mechanic productivity, the relative priority for repair of various vehicles, repair time expectations, and minimizing downtime of units. SOPs should also address standards and procedures with regard to enhanced and consistent improvement of customer service. Most importantly, the SOPs must establish strict schedules and rules for an unwavering, comprehensive, and consistent PM program for the entire fleet.

Appendix III lists specific topics the SOP should cover. This list was developed in consultation with Mercury Associates and other fleet management industry sources.

5.5.2 Summary of Findings

93. The AD has no fleet management SOPs or handbook which specifically governs the non-uniformed foreman, mechanics, ticket writers, dedicated PM schedules or procedures, and Shop operations.

94. There is no written mechanism within the organizational structure, procedurally or otherwise, which systematically addresses work that is in the process of being done or work that is to be done.

5.5.3 Recommendations

112. Develop and maintain a comprehensive AD Policy and Procedures Manual which governs all aspect of the AD including management practices, employee evaluations, Shop operations, performance measures, dedicated PM schedules, etc. (see Section 5.5).

113. A wide cross-section of stakeholders should collaborate to develop the Policy and Procedures Manual that covers the topics listed in APPENDIX I.

5.6 Procurement Issues

Some aspects of apparatus procurement unwittingly hamper the AD's ability to keep the fleet running. Fire apparatus are competitively procured by the D.C. Office of Contracting and Procurement (OCP) on behalf of FEMS. The procurement cycle can be very long, even for purchases of small numbers of apparatus. The long lead times make apparatus replacement planning difficult. In recent years, there have been a number of "false starts" which have necessitated vendors resubmitting bids – adding time, expense, and frustration to their process.

Changing the way apparatus are procured could improve the quality of the apparatus procured, increase FEMS' ability to adhere to a fleet replacement plan, and ensure that vendors give better support to the AD. It is important to note that some of the changes discussed in this section could require a change in procurement policy from the Mayor and/or the D.C. Council.

5.6.1 Procurement Contracts

Whenever apparatus need to be procured, OCP solicits bids from vendors (i.e., apparatus manufacturers). Vendors receive a set of apparatus specifications – detailed requirements about how the apparatus must be built or perform. Based on the District's specifications, each vendor then submits a bid which tells the District the cost of each piece of apparatus and how long each will take to deliver. The selected vendor is then issued a contract to deliver a specified number of apparatus over a certain period of time.

5.6.1.1 *Contract Length*

With the exception of some post-9/11 purchasing that occurred when the federal government was trying to bolster emergency response capacities nationwide, contracts with vendors generally have been short-term and limited in scope – valid for a small number of units over 1 to 2 years.

We strongly believe that the District would benefit greatly by issuing apparatus contracts for extended periods – between 5 and 8 years. Longer contracts would be more attractive for vendors, thus incentivizing them to offer FEMS more in terms of price, warranty conditions, technical support and training for mechanics and field personnel, and willingness to accommodate FEMS' special requests and specifications. In addition to these improved conditions, FEMS would benefit by having a single supplier for a given class of apparatus for an

extended period. This would result in more stability for the AD in terms of mechanic knowledge and experience as well as having to stock parts for fewer manufacturers.

Manufacturers have a vested interest in acquiring and retaining long-term customers. Forcing vendors to compete for a few apparatus each year means that they have to go through a long process with an uncertain outcome each time. This increases the price to the District because the vendor must build in the cost of submitting a bid (i.e., researching the specifications, calculating build costs, writing a proposal, etc.). Vendors would much rather bid once and lock in a contract that is good for several years.

In return for a longer contract, more should be asked of vendors than is possible to ask of them under the current system. BFD was able to obtain a 5-year, bumper-to-bumper warranty from KME/Kovatch Mobile Equipment Corporation, its fire engine vendor. There is no doubt that FEMS could obtain similar warranty coverage from an incentivized vendor, and such coverage ought to be a bid requirement. With a longer contract, the AD could also require vendors to conduct annual comprehensive in-service training for mechanics. Vendors could also be required to provide online service manuals and expanded technical support for a certain number of years beyond the end of the contract. Additionally, vendors could be required to post a performance bond over the life of the contract.

5.6.1.2 *Contract Vehicles*

One option to go to a longer contract would be awarding an indefinite delivery/ indefinite quantity (IDIQ) contract for a certain class of apparatus, with the specific number of vehicles delivered in each year of the contract to be determined from year to year. Another option would be to award a vendor a fixed-price contract to deliver a certain number of units each year over a predetermined period. Irrespective of the type of contract vehicle selected, the contract should be for a sufficiently long period to make it attractive to the vendor.

5.6.1.3 *"Best-Value" Contracting*

FEMS is generally required to award apparatus contracts to the lowest bidder. This is not a sound award approach for something as technically complicated and expensive as fire/EMS apparatus, especially when factors such as design, engineering, quality, and ability to deliver according to schedule are as important as – if not more important than – price.

Low-bid contracting only encourages vendors to provide the minimum acceptable apparatus at the lowest price. This incentivizes vendors to cut corners and provide as little technical support as possible in an effort to keep costs low.

We believe that FEMS would be better served by awarding contracts on a "best-value" basis – in other words, FEMS could award a contract to vendor which had submitted a higher bid which

offers a better value to the District because of the quality/features of the apparatus and/or warranty/technical support promised.

5.6.2 Apparatus Specifications Development

Apparatus specifications tell manufacturers the exact parameters of what a client wants in a given piece of apparatus. Specifications can dictate everything and anything about the apparatus, including the length, width, weight, engine power, electrical wiring, paint color, siren type, and location and size of compartments. Some purchasers want "nice to have" features such as a certain type of seating or fancier emergency lighting. In the some cases, however, specifications address real, functional issues such as weight limits or water-carrying capacity because road/bridge construction or a lack of access to fire hydrants necessitates designs that are not accommodated in commercial (i.e., factory standard) apparatus. In Washington, DC, narrow, congested roadways and older fire stations with narrow bay doors (which were designed for smaller fire apparatus of years past) dictate some specifications. Other specifications are driven by a desire to maintain consistency and standardization throughout the fleet.

5.6.2.1 *Apparatus Committee*

The FEMS Apparatus Committee develops the specifications and works to assure that apparatus are built according to these specifications. The Committee consists of the Deputy Chief in charge of the AD and several subject matter experts from within the Department, but its composition warrants some attention.

Best-practice fire/EMS departments usually have a good cross-section of personnel represented on such committees. This generally includes firefighters, who drive and work from the apparatus, as well as mechanics, who maintain the apparatus, because both groups can contribute input based on "hands-on" experience from their respective vantage points. Fire and EMS apparatus must be designed to meet the needs of field personnel, but seeking the input of mechanics can result in design changes that have little bearing on field operations but which can greatly simplify needed repairs, thereby reducing time out of service at the shop.

There is some disagreement as to the level of participation of FEMS mechanics on the Apparatus Committee. We heard from some AD management and leaders that mechanics are represented on the Apparatus Committee; however, the mechanics with whom we spoke state that they are rarely asked to participate and that they must live with the decisions made by the Committee – which, in some cases, are not ones they would have endorsed.

We strongly endorse the full participation of FEMS mechanics on the Apparatus Committee. The AD should ensure that mechanics, not just foremen, are actively involved in all aspects of the Committee's work, including specifications development and apparatus acceptance.

5.6.2.2 *Standardization across the Fleet*

Standardization of each class of apparatus across the fleet offers a number of benefits.

First, it makes it easier for firefighters to work in different stations because equipment placement on and operation of apparatus is the same irrespective of the station. Second, it makes changing over apparatus easier and faster if firefighters do not have to figure out the best location to stow equipment on a different piece of apparatus.

Third, standardization improves maintenance and repairs because mechanics have fewer vehicle designs to learn. When apparatus components such as primer pumps, siren wiring, batteries, etc. are in the same location on every unit mechanics don't have to figure out and deal with idiosyncrasies. This means they can be more proficient and efficient at identifying and making needed repairs. When a mechanic opens the engine compartment of a vehicle, the view should be as identical as possible with other vehicles in that class.

Fourth, the amount and value of parts kept in inventory can be reduced because fewer different parts are needed to effect repairs.

Finally, standardization plays a role in ensuring that apparatus can move seamlessly across the city and can be utilized as reserve apparatus anywhere. FEMS has many fire stations that are decades old and date back to a time when fire apparatus was considerably smaller. Fitting new, larger vehicles in these older, narrower stations can be problematic (see Figure 43). To that end, standardization increases operational flexibility. For example, Engine 22's apparatus bay is very tight, while Engine 24 – just down the road – has quarters that are considerably wider. Apparatus that fits in Engine 24's bay might not fit in Engine 22's bay, thus limiting FEMS' ability to relocate apparatus. Likewise, vehicles in the Ready Reserve and Reserve fleets must be able to fit into the smallest fire station bays. Standardization minimizes this issue.

Figure 43. Ambulance 22 in Tight Quarters

5.6.2.3 *Custom versus Commercial Apparatus*

One means to obtain standardization and lower costs is to order "commercial" (i.e., factory standard) apparatus. The alternative to commercial is "custom" (i.e., built to client specifications with few, if any, factory-standard options). An intense debate rages in the national fire service about the benefits of custom versus commercial apparatus, with adherents on both sides vociferous in their beliefs that one is better than the other. The bottom line is that neither side is right – there is no "one" correct approach to buying apparatus. The pros and cons of each option must be weighed.

In the case of FEMS, we believe that it is likely that commercial apparatus that can fit in FEMS' smaller stations can be procured, and that it will suit the Department's needs and save it money. Given the high call volume, tough driving conditions, and potential for collisions, the benefits of keeping apparatus design, construction, and procurement as simple and inexpensive as possible argue for selecting commercial apparatus.

5.6.3 Factory Visits

The apparatus purchase process generally involves three meetings at the factory.

The first meeting is to finalize the engineering plans for the vehicle, and generally takes two full workdays to accomplish. This meeting is held at the factory so that when questions about different vehicle components or construction methods arise the committee can quickly address them with engineers and see examples on the factory floor.

The second site visit is the "post-paint" inspection. This visit is conducted after the body of the apparatus has been mounted to the chassis, but several weeks before the vehicle is completed. This is a very important meeting. At this point in the construction process, changes to the vehicle can still be made relatively easily and comparatively inexpensively.

The third meeting is the final acceptance inspection of the completed apparatus. This is used to verify that all work has been satisfactorily completed according to contract and to identify any defects that must be addressed by the manufacturer prior to acceptance. It is far easier to deal with such defects at the factory than to have FEMS personnel deal with manufacturer's representatives once the vehicle has been driven back to Washington, DC.

Elective changes to a completed vehicle are much more difficult and considerably more expensive to effect. Every effort must be made to identify any desired changes during the post-paint inspection, and not at the final inspection.

None of these meetings should be considered optional. They are all crucial to ensuring that the District receives a high-quality piece of apparatus. The cost of sending Apparatus Committee members on these trips should be built into the procurement, and any trips for re-inspection necessitated by a construction defect should be fully borne by the manufacturer. Accordingly, FEMS should always ensure that the most qualified members of the Apparatus Committee – irrespective of rank – perform these factory visits. The only exception to this rule would be that if GSA were to procure apparatus on behalf of FEMS, GSA personnel could make the site visits on behalf of FEMS personnel.

5.6.4 GSA Procurement Option

GSA can conduct apparatus procurements on behalf of OCP, using FEMS-developed apparatus specifications. FEMS and OCP should explore this option, as it offers several benefits. First, the federal government regularly purchases fire and EMS apparatus, so GSA contracts personnel are already familiar with potential suppliers and how to evaluate the proposals they submit. Second, GSA will handle the procurement from cradle to grave, freeing up FEMS and OCP personnel to deal with other matters. Third, FEMS can capitalize on the considerable purchasing power of the federal government.

Of course, ceding procurement responsibility to GSA means giving control of the process and outcome to an agency other than FEMS. While this may not be palatable to some, the cost savings may outweigh such concerns. Ultimately, this decision must be left to FEMS leadership.

5.6.5 Ambulance Procurement

Wise ambulance procurements can have a significant impact on the AD because ambulances account for such a large portion of the FEMS fleet and because they are essential apparatus on the vast majority of FEMS' workload.

5.6.5.1 *Ease of Maintenance*

As discussed in Section 4.1.2.5.1, the International Harvester ambulances are easier to maintain than the Ford ambulances because the former have tilt cabs that afford mechanics easy access to the engine and other critical systems. Future ambulance procurements should favor designs such as this that facilitate maintenance.

5.6.5.2 *Air Conditioning*

During the physical inventory, the Project Team witnessed numerous ambulances on the street during nearly 100-degree weather without working air conditioning in either the cab or the patient compartment. It is simply not acceptable for the welfare of either the patient or the crew for an ambulance to be without air conditioning in extreme heat. The temperatures in the patient compartment can quickly rise to a level that would subject EMS personnel and patients to the risk of heat exhaustion or heat stroke. Given the District's extremely hot summers and bitterly cold winters, working climate control for both the front and the back of ambulances must be considered essential, not optional.

One of the problems with ambulance air conditioning is the placement of the compressors. In some applications, compressors are mounted on the roof of the cab – a less-than-optimal position that interferes with emergency lighting. Alternatively, compressors are mounted under the patient compartment. This means that the heat from the compressor is disseminated around the very area that needs to be cooled down. Horton Emergency Vehicles, an ambulance manufacturer based in Ohio, has developed a novel roof-mounted air conditioning system which allows heat to vent directly away from the patient compartment. Horton claims that this system, the Cool-Tech II, is capable of delivering 100,000 BTUs of cooling and is easier to maintain than current systems. These features warrant close consideration of this system. This system – or something similar – should be considered an advantage in selecting between vendors.

At the very least, ambulances should be equipped with dual, heavy-duty compressors for air conditioning. Relying on factory air conditioning (i.e., that comes with the chassis) is not sufficient, as a single-compressor system is not powerful enough to cool both the cab and the patient compartment. Further, given that ambulances run virtually all day long in many cases, it is easy for the air conditioning system to get overworked and fail. When this happens, an ambulance really should be put out of service.

5.6.5.3 *Ambulance Emergency Lighting Systems*

Until only recently, FEMS ambulances were procured according to GSA ambulance procurement specification, KKK-A-1822F. The emergency lighting package specified in this document is "bare bones." It provides minimally acceptable visual warning of an approaching ambulance, but most EMS professionals regard the design of the system as inadequate to alert drivers perpendicular to the direction of travel. Given that most ambulance crashes occur as ambulances

are attempting to negotiate intersections, visual warning systems that do not exceed the KKK-A-1822F specifications do not provide optimal protection. In the heavily urbanized driving of Washington, DC, where there are thousands of intersections, this presents a real problem.

Emergency lighting in the KKK-A-1822F specification is located near the top of the patient compartment. On the International Harvester ambulances, these lights may well be out of view from the rearview mirror of many passenger vehicles when the ambulance is close to the vehicle.

Because of these shortcomings and in order to afford FEMS ambulances the best visual warning possible to avoid collisions, ambulances should be procured with emergency lighting systems that exceed the requirements of KKK-A-1822F. Specifically, we recommend that ambulances be equipped with grill-mounted flashing lights to enhance their conspicuity in rear-view mirrors and with lighting that makes them more visible perpendicular to the direction of travel.

5.6.6 Summary of Findings

95. The short contract term of current FEMS apparatus procurements works against FEMS' best interest. Vendors would have considerably more incentive to offer better prices and service if were offering longer-term apparatus contracts.
96. Awarding apparatus contracts based solely on price is not in the best interest of FEMS. "Best-value" awards offer FEMS the flexibility to consider additional factors which are every bit as important as price.
97. There are differing opinions as to the level of participation of FEMS mechanics on the Apparatus Committee. Mechanics can offer substantial insight in the development of apparatus specifications and thus fill an important role on the Committee.
98. Standardizing apparatus by class across the fleet offers FEMS substantial operational, financial, and maintenance efficiencies and benefits.
99. The small apparatus bays of some older FEMS stations limit the size of the apparatus that can be placed there. Obtaining maximum flexibility in what apparatus can be used – either in frontline or reserve status – in those stations requires that apparatus be standardized to fit in the smallest station.
100. FEMS could most likely procure commercial apparatus that is sized to fit FEMS stations and which will cost substantially less than custom apparatus.
101. Apparatus factory visits are crucial to the procurement process and should not be viewed as optional.
102. GSA can perform apparatus procurement on behalf of OCP and FEMS.
103. Engine placement and access in the Ford ambulances hampers the ability of the Shop to maintain and repair these units. In contrast, engine placement and access in the International Harvester ambulances facilitates maintenance and repair.

104. Numerous ambulances were noted to have inoperable air conditioning on some of the hottest days of the summer. Patient compartment temperatures were unhealthful for patients and EMS personnel alike.

105. Emergency lighting systems that are compliant with the KKK-A-1822F ambulance procurement specification may not offer sufficient protection in a heavily urbanized environment with lots of intersections.

5.6.7 Recommendations

114. The District should issue apparatus contracts for extended periods – between 5 and 8 years in order to incentivize vendors to offer FEMS more in terms of price, warranty conditions, technical support and training for mechanics and field personnel, and willingness to accommodate FEMS' special requests and specifications.

115. FEMS should utilize "best-value" rather than "lowest bid" contract awards.

116. The AD should ensure that mechanics, not just foremen, are actively involved in all aspects of the Committee's work, including specifications development and apparatus acceptance.

117. FEMS should seek to standardize apparatus types across the fleet whenever possible.

118. FEMS should endeavor to order commercial apparatus whenever possible.

119. The most qualified members of the Apparatus Committee – irrespective of rank – should perform these factory visits.

120. Consideration should be given to having GSA procure apparatus for FEMS.

121. Ease of maintenance should a factor to be considered when evaluating ambulance designs and vendor bid submissions.

122. A working climate control system should be regarded as mandatory on all in-service ambulances. Any ambulance which loses climate control should be taken out of service.

123. FEMS should give strong consideration to procuring ambulances equipped with the Cool-Tech II air conditioning system, or some other system that offers similar advantages with respect to heat dissipation, cooling capacity, and ease of maintenance.

124. Ambulances should be equipped with grill-mounted flashing lights to enhance their conspicuity in rear-view mirrors and with lighting that makes them more visible perpendicular to the direction of travel.

SECTION 6. STATION-BASED OPERATIONS

This section discusses in-station operations and their impact on Apparatus Division operations.

In the fire service, there are numerous in-station activities that have an impact on the condition of the apparatus, which ultimately has an impact on the operations of the AD. This section discusses those in-station activities and makes recommendations for improvement. Some of these areas of discussion have been briefly introduced in Section 3.4.7.2 (Automated Vehicle Inspection Technology) and Section 5.3.2 (Best Practices).

6.1 Improving Vehicle Checkouts

The daily checkout of FEMS apparatus is a golden opportunity to spot and report problems before they become big problems (or even catastrophic failures). Unfortunately, FEMS is not taking advantage of this opportunity. Currently, FEMS apparatus operators and technicians perform a daily checkout on their vehicles using FEMS Form 54. This paper-based checkout form is fairly useless. It is easy for an operator to complete the form without having performed any real safety or maintenance checks. Because the form is not automated, there is no ability to capture any relevant data or use the information learned during the checkout to the advantage of the AD. Completed forms are filed away and are only reviewed when someone conducts an investigation after a problem surfaces. Any number of people with whom we spoke during our interviews and the inventory process indicated that daily vehicle checkouts were rushed, incomplete, or skipped entirely. Implementation of the ZONAR system would be a measurable step forward towards solving this problem.

To perform a checkout using the ZONAR system, the vehicle operator moves between designated checkpoints on the vehicle. At each checkpoint, the operator uses the ZONAR handheld to read an RFID tag mounted there. Once the RFID tag is read, the handheld displays questions pertinent to that portion of the vehicle, and the operator enters the appropriate information into the handheld. All information required for that checkpoint must be entered before the operator can proceed to the next checkpoint. This ensures that needed inspections are performed and facilitates the capture of relevant data electronically.

The system knows how long the inspection at each checkpoint should take, and it will not allow an operator to simply walk around the vehicle, scanning RFID tags, without actually taking the time to complete the inspection. Because each step of the checkout process is timed, individual operator checkout performance can be measured, monitored, and evaluated. The system can notify an appropriate manager if an inspection is either too long or too short. This would assist company officers and the AD in ensuring that the required daily checks are completed. Because the system depends on the use of RFID tags, rather than barcodes or QR codes (the little black-and-white patterned squares), the system cannot be circumvented.

Implementation of the ZONAR system in FEMS would convert the missed opportunity created by skipping required morning checkouts into a means to funnel valuable information through FASTER to the AD. For example, if an apparatus operator identifies a deficiency during the daily checkout, the ZONAR handheld can automatically create a deficiency report and a work order in FASTER. In this manner, deficiencies can be systematically logged and prioritized for remediation. Finally, and most importantly, ZONAR ensures incontrovertible accountability for the performance of daily in-station vehicle inspections and the entry of work orders for the Shop.

6.1.1 Summary of Findings

106. Required daily vehicle checkouts are not being performed consistently and well across the FEMS enterprise. There is no accountability or QC built into the checkout process.
107. The results of vehicle checkouts cannot be analyzed because checkout results are not recorded electronically.
108. Deficiencies found during the checkout process must be manually reported to the AD.

6.1.2 Recommendations

125. Implement the ZONAR system on a pilot basis (one or two stations) to establish a proof of concept. If the pilot is successful, FEMS should expand the program to the whole FEMS emergency fleet.

6.2 Station-based Deficiency Reporting

As discussed in Section 5.3.2.9, best-practice fleet organizations rely on station-based deficiency reporting to report, coordinate, and schedule maintenance and repairs.

FASTER Service Center provides field-based deficiency reporting as a component of the FASTER application; however, FASTER Service Center is not being used by FEMS. Presently, defects are reported to the AD via e-mail. Since these e-mails are not integrated into FASTER, the specific defects reported must be manually transferred from the body of the e-mail into a FASTER work order. This causes several problems:

1. It increases the likelihood of a transcription error.
2. It creates work for someone within the AD.
3. It creates the possibility that a report is delayed (if the e-mail system is down or is not checked for some reason).
4. It creates the possibility that the e-mail is overlooked or lost permanently, meaning that the deficiency effectively is never reported.
5. It causes a delay in when the deficiency is noted in FASTER, which skews any metrics which use the time of the initial report (i.e., an automated system would correctly

timestamp the report, whereas reports that are transferred from e-mails will be time-stamped as of the time the work order is entered).

A station-based reporting capability creates greater accountability because an auditable record of the submission is created and can be used for performance measurement purposes. Additionally, such a capability allows fleet administrators to analyze submission information to identify trends and to create work efficiencies. For example, Montgomery County uses its reporting system to schedule mobile repairs and drop-offs of requisitioned disposable items such as vehicle fluids and replacement light bulbs.

Section 25 of FEMS Article XX requires seven people in the reporting chain to be e-mailed to request repairs. This is inefficient for both the requestor and the people whose in-boxes are clogged with these requests. It would be more effective if the reporting and request for repairs were loaded directly into the FASTER system at the station level. This would generate an immediate notification and reporting mechanism within the system which would in turn help to improve the documentation, data collection, and accountability. Having repair requests entered directly into FASTER will also help with respect to performance measurement because it will allow the *scheduled repair rate* to be managed and tracked more effectively because operator's inspections and repair requests, service writer's work orders, and supervisory and management notification/status tracking will be consolidated into a central database.

6.2.1 Summary of Findings

109. The current system of e-mailing the AD (and others) about needed repairs allows too many repair requests to "slip through the cracks" and it does not permit such requests to be time-stamped and entered into an auditable system which ensures accountability for the disposition of such requests.

110. Article XX's requirement that seven people be notified via e-mail of every repair request is a legacy of an ineffective vehicle deficiency notification system.

6.2.2 Recommendations

126. FEMS should change Section 25 of Article XX to require vehicle deficiency notifications and repair requests to be entered into FASTER (or a similar application) at the station level, in lieu of the current e-mail system.

6.3 In-Station Maintenance and Repairs

Section 25 of FEMS Article XX, succinctly sums up the purpose and mission of the vehicle operator's responsibilities as well as the essence of their part of the all-important link in the preventative maintenance chain:

> "The vehicle operator is the first line of defense in the maintenance team. He/she will often notice small defects in the apparatus and can take the necessary corrective action before the small problem becomes a major one."[54]

Article XX goes on to state:

> "All vehicle operators will be responsible to perform the checks outlined herein, which are appropriate for the type of vehicle that they drive and operate."

The Project Team believes Article XX to be a credible and overall comprehensive document which succinctly and clearly lays out the responsibilities and tasks needed for keeping abreast of the condition and primary maintenance requirements of the apparatus under the purview of technicians within the fleet. They are practices which can be reasonably conducted in-house without compromising the safety or operational functioning of any apparatus in the fleet and without necessitating outsourcing of these basic functions and services.

The parameters set for the level and content of specific tasks they are able to perform are clear, concise and appropriate for the technician's collective level of involvement in the maintenance chain. Section 22 of the document clearly spells out the items, procedures and limitations on what the technicians should inspect and maintain on the apparatus. Section 23 and the recently added Special Order 2013-25 are equally clear and set specific rules and regulations for the prohibition of any unauthorized alterations or repairs to apparatus. We believe these restrictions are appropriate. There is one area that is open to an increased option for effecting basic repairs not listed in the current document. An example of a simple repair that may be considered as an option is to have in station personnel be allowed to change burned out light bulbs on simple applications found on apparatus. This should not involve the repair of the fixtures themselves, nor include the repair or tampering with any wires connected with those appliances, but minor maintenance tasks only.

6.3.1.1 *Vogel Lube Systems*

Modern fire apparatus is frequently equipped with a Vogel Lube System. It is an option for which fire departments pay extra. The Vogel Lube System is designed to ensure that expensive apparatus is properly lubricated automatically. In some respects, it is an in-house PM program that is always at work protecting apparatus.

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[54] FEMS Article XX, page 13.

The Vogel Lube System takes both apparatus operators and Shop personnel out of the equation when it comes to keeping critical vehicle components lubricated. When the system is in service, the lubrication is done automatically without having to place the vehicle out of service and without worrying about accessing critical lubrication points on the vehicle.

During the course of the apparatus inventory, the Project Team heard incessantly from technicians who reported that the Vogel Lube System on their apparatus had been out of service for a long time. One person with whom we spoke indicated that the systemic failures of the Vogel Lube Systems were due to the use of incorrect lubricants, but we were unable to confirm this report. The cause for the failures, however, is less relevant than the fact that these crucial systems have been allowed to remain inoperable for long periods of time.

6.3.2 Summary of Findings

111. A properly trained apparatus operator (i.e., technician) should be able to accomplish a variety of routine, simple in-station maintenance and repairs. Doing so eliminates the need to bring the apparatus in to the Shop, resulting in the unit staying in service in the community longer and reducing the demand for service at the Shop.

112. Numerous failures of Vogel Lube Systems endanger the serviceability of apparatus.

6.3.3 Recommendations

127. FEMS should amend Article XX Section 22 and Special Order 2013-25 to include permit qualified station personnel to perform simple repairs and minor maintenance tasks, such as changing burned out light bulbs. Authorized in-station repairs should not include anything associated with sophisticated electronics systems (i.e., communications equipment, on-board computers, emergency lighting or siren system) or engine components (other than topping off fluid levels).

128. All technicians should receive in-depth training from the AD about the types of repairs they are expected and authorized to undertake in the station. No repairs should be authorized by personnel who have not received training to make them.

129. All Vogel Lube Systems should be inspected, restored to working condition (if necessary), and maintained in accordance with manufacturer's specifications.

SECTION 7. IMPACT OF ISO RATING CHANGE

This section discusses the potential impact of changing the District's Insurance Services Office rating.

7.1 Overview of the Insurance Services Office Rating

At the time of this study, FEMS officials were contemplating possible resource changes that could affect the number of fire vehicles deployed throughout the District. Like most cities in the United States, the majority of calls handled by FEMS are calls for emergency medical service. With this in mind, essentially two questions were posed by the Department's leadership to the Project Team:

1. What would be the effect on emergency service delivery in DC if the District's Insurance Services Office (ISO) rating were changed from Class 2 to a Class 3?
2. What effect, if any, would there be on the District's ISO rating if some of the District's fire suppression resources were eliminated to provide additional EMS capabilities?

Since the 1800s, insurance companies have been involved in one way or another in "rating" fire departments. As cities grew and buildings became larger and communities more industrialized, insurance companies sometimes incurred large losses from fires. Much of the time, these losses were due to inadequate water supplies and ineffective fire suppression capabilities. To help reduce losses, insurance companies developed criteria to evaluate community fire suppression capabilities and to quantify the level of service provided. Once quantified, insurance companies used the information (rating) to determine and assign fire insurance rates. The emphasis then, as now, was primarily to reduce dollar loss from fires. Though improving water supplies and fire suppression can and does improve life safety, the purpose of rating fire departments is to adjust insurance rates to lessen insurance company losses.

ISO uses data and information provided by each community to derive a Public Protection Classification (PPC). Community evaluations are performed periodically or when there is reason to believe there may be a change in the PPC. As it is intended, the PPC is only used to assess a community's fire protection – it does not consider other emergencies or important services provided by the fire department such as EMS, technical rescue, or hazmat incident mitigation calls. The ISO acknowledges the use of the PPC is limited to assessing *fire suppression capabilities* and that fire departments do many more things to improve public safety.

7.1.1 Fire Suppression Rating Schedule

To determine the PPC, ISO uses the Fire Suppression Rating Schedule (FSRS). The FSRS has three primary components, each of which is a portion of the overall final score under the FSRS. The components evaluated by ISO and their percentages of the total rating are:

- Receiving and Handling of Alarms – 10 percent
- Fire Department – 50 percent
- Water Supply – 40 percent

Under the FSRS, community fire protection is rated from 1 to 10. One is the best rating and signifies that the water supply, fire department and alarm handling (dispatch) systems are first rate. On the other end of the scale, a rating of 10 means that a community does not meet the minimum qualifications to be rated by ISO as its fire suppression capabilities are mostly non-existent. Of the over 48,000 fire communities evaluated by ISO, only 62 have a Class 1 rating under the FSRS. The District of Columbia current has an ISO rating of 2, which is excellent. Only about 600 of the 48,000 (1.3 percent) fire protection areas rated by ISO have this low of an ISO rating. The majority of communities have ratings in the Class 5 to Class 7 range.

7.1.2 Resource Changes and Impact on the District's ISO Rating

The District was last rated by ISO in 2010. Its rating from the evaluation was determined to be Class 2, based on its total score of 84.66. In the evaluation, the District scored highest in the areas of water supply and handling alarms. The scores the District received in these areas are indicative of a Class 1 system. The Fire Department score was equivalent to Class 2.

The tabulation from the 2010 ISO evaluation is depicted in Table 36 (on page 167). It shows that the FSRS scores were best overall in Handling of Alarms and Water Supply. In these areas, the District received 9 of a possible 10 points for Alarm Handling and 38 of 40 points for Water Supply. The Fire Department category received 41 of 50 points, with company staffing and training scoring lowest, 12 of 15 points and 5 of a possible 9 points, respectively.

In terms of the final score and PPC rating, the District could lose 4.6 points and still retain its Class 2 rating. This is because Class 2 communities can have an overall score of 80.01 and still be Class 2. A score of 80 or less is Class 3 under the PPC. So long as there are no changes to the Alarm Handling or Water Supply systems, any reduction in the FSRS less than 4.5 points within the Fire Department category would not affect the Class 2 rating.

Based on the October 2010 ISO review, the number of engine and ladder companies deployed by the District provided very good scores: 8.7 of 10 points and 4.7 of 5 points, respectively. If the Department were to eliminate fire suppression units, this would be the category most affected. Again, however, the District could likely make minor changes to its deployment model and still retain its Class 2 rating.

Table 36. Washington, DC ISO Scoring (2010)[55]

CATEGORY	EARNED CREDIT	POTENTIAL CREDIT
Receiving & Handling Alarms		
- Telephone Service	2.00	2.00
- Operators	3.00	3.00
- Dispatch Circuits	4.05	5.00
Subtotal	***9.05***	***10.00***
Fire Department		
- No. Engine Companies	8.67	10.00
- No. Reserve Engines	0.87	1.00
- Pumping Capacity	5.00	5.00
- No. Ladder Trucks	4.68	5.00
- No. Reserve Ladder Trucks	0.93	1.00
- Distribution of Engines and Trucks	3.45	4.00
- Company Staffing	11.99	15.00
- Training	4.95	9.00
Subtotal	***40.54***	***50.00***
Water Supply		
- Supply System (Volume)	32.84	35.00
- No. Hydrants (Distribution)	2.00	2.00
- Inspections	2.86	3.00
Subtotal	***37.70***	***40.00***
Divergence[56]	-2.63	
TOTAL SCORE	**84.66**	**100.00**

Not all insurance companies use the PPC system. Of those that do, some insurance companies band the ratings such that residential and light commercial properties get the same insurance rate for multiple ratings, Class 2 through Class 5, for example. Rates change appreciably only for PPC Class 5 and above. State Farm Insurance does not even use ISO. Instead, it has its own proprietary rating system. Thus, in the unlikely scenario that the District's ISO rating did go from Class 2 to Class 3, it is unlikely that insurance rates for residential and light commercial property owners would be affected much. Those seeing the most impact would be high-risk manufacturing properties. There are, however, few of these in the District and they are individually rated anyway.

There are also other factors to consider as to how fire suppression capability reductions, if any, might negatively impact the District's current Class 2 ISO rating. First, as was mentioned earlier, the overwhelming demand for services in the District is for EMS. Under the ISO rating system EMS calls are not even considered as part of the assessment. Another factor is that the vast

[55] Public Protection Summary Report, Washington, District of Columbia, October 2010, pg. 35.

[56] http://www.isomitigation.com/ppc/3000/ppc3013.html: FSRS scores are subject to modification by a divergence factor, which recognizes any disparity in the effectiveness of your fire department and water supply. The divergence factor mathematically reduces the preliminary scores if the fire department and water-supply scores are out of line with each other.

majority of large structures in the District are government-owned. These structures would not be impacted by any change to the ISO rating because they are self-insured.

7.1.3 Discussion of Possible ISO Rating Change

Determining the exact impact of any changes in the fire suppression capabilities based on ISO's FSRS is not possible without knowing the specifics of the proposed changes. In general, however, if minor changes are made such as eliminating one or two engines or ladder trucks, it is probable that little, if any, change would occur to the ISO rating. Part of the reason is because insurance companies use the PPC to determine the insurance rates for residential and light commercial properties. Insurance rates for large commercial and industrial risks are determined on an individual basis by the insurance carrier.

To assess the full impact of any proposed changes, a larger study should be conducted. Likewise, FEMS should also confer with ISO technical staff to understand the impact to the PPC classification, if a particular change is being considered. In these cases ISO can often provide a summary review based on how the system might look.

District officials are encouraged to consider not just ISO when assessing the impacts of a particular service change. Improving EMS response and providing special capabilities to handle major non-fire emergencies are two areas that were not part of the business portfolio of fire departments when the PPC rating system was developed. As the recent situation at the Washington Navy Yard shows, fire departments do much more than fight fires. Evaluating their effectiveness requires more than just determining the ISO PPC rating.

APPENDIX I. FULL APPARATUS INVENTORY

The full physical inventory conducted as a part of this study has been submitted to FEMS as an Excel spreadsheet.

APPENDIX II. GLOSSARY OF KEY TERMS AND ACRONYMS

AD	Apparatus Division
ASE	Automotive Service Excellence – the leading third-party certification for mechanics
BFD	Boston Fire Department
BPWG	Best Practices Working Group
COTS	Commercial-Off-the-Shelf (i.e., a software product that is commercially available, as opposed to one that has been developed from scratch)
DPW	D.C. Department of Public Works
EMS	Emergency Medical Services
EVOC	Emergency Vehicle Operations Course – A nationally standard course developed by the U.S. Department of Transportation to train operators of all types of emergency vehicles
EVT	Emergency Vehicle Technician – a certification for mechanics who have demonstrated knowledge and skills specific to emergency vehicles
FASTER	A Web-based fleet management information system application in use by DPW, MPD, and FEMS.
FEMS	D.C. Fire and Emergency Medical Services Department
FMIS	Fleet Management Information System
FSRS	Fire Suppression Rating Schedule
HVAC	Heating, Ventilation, and Air Conditioning
MPD	D.C. Metropolitan Police Department
MRU	Maintenance and Repair Unit
NAFA	National Association of Fleet Administrators
OEM	Original Equipment Manufacturer
OOB	Out-of-the-Box – turnkey software that is characterized by a more rigid user interface and includes user-defined business rules built into the core application
OOS	Out of Service
PM	Preventative Maintenance
PPC	Public Protection Classification
RFID	Radio-frequency Identification

SLA	Service-level agreement
SOP	Standard Operating Procedure
VEU	Vehicle Equivalency Units

APPENDIX III. SUGGESTED APPARATUS DIVISION POLICIES AND PROCEDURES

Administrative

- Fleet Organization
- Fleet Contacts List
- Vehicle Inspection, Licensing, and Registration
- Fleet Information Systems
- Vehicle Key Control
- Fuel Card/Key Control
- Fleet Department Performance Reports
- Recordkeeping Requirements
- FASTER/IT Requirements
- Customer Complaints
- Internal Service Fund and Charge-back Procedures
- Garage and Facilities Maintenance and Security

New Vehicles and Equipment

- Lease/Purchase/Reimbursement Analysis
- Repair/Replace Decisions
- Adding a Vehicle to the Fleet
- Demonstration Equipment
- Replacement Guidelines
- Developing Specifications
- Ordering Vehicles and Equipment
- Vehicle Delivery Status Reports
- Vehicle Receiving and Verification
- Preparation for Service
- New Vehicle Operator Training
- Alternative Fuel Vehicle Program

Vehicle Operation

- Fueling
- Use of Passenger Vehicles
- Vehicle and Equipment Utilization
- Driver and Operator Training
- Driver/Operator Responsibilities
- Operating Department Supervisor/Coordinator Responsibilities
- Equipment Misuse or Abuse
- Accident Claims/Risk Management
- Accident Procedures
- Temporary Vehicle Requirements

- Emergency/Inclement Weather Operations
- Emergency Procedures
- Driver Licenses And Driving Records

Maintenance

- Preventative Maintenance Defined
- Preventative Maintenance Responsibilities
- Preventative Maintenance Vehicle Schedule
- Prioritization of Repairs Schedule
- Unplanned maintenance
- Field Breakdowns
- Warranty Repairs
- Contract repairs
- Vendor Performance Evaluation
- Body and Paint Work
- Repair/Rebuild/Remanufacture/Replace Analysis
- Vehicle Modifications
- Parts
- Labor Reporting Standards
- Emergency Road Service
- Management Training
- Mechanic Training
- Mechanics' Required Tools and Equipment
- Disposition of Unsafe Vehicles
- Documentation
- Occupational Safety and Health Program
- Quality Program

Equipment Disposal

- Authority for Disposal
- Preparing Vehicles and Equipment for Disposal
- Procedures for Disposal

Forms

APPENDIX IV. BEST PRACTICES IMPLEMENTATION

This appendix provides a prioritized timeline for implementation of the best practices discussed in Section 5.3.2. The following are definitions for the priorities described in this appendix.

Essential	Implement the practice at the earliest possible time. Failure to implement the practice described could compromise efforts to prevent errors, improve primary operations, or increase efficiencies, thereby interfering with FEMS' mission to provide emergency services to the public.
Short-Term	Implement the practice by the end of Fiscal Year 2014. These practices should be viewed as "low-hanging fruit."
Medium-Term	Implement the practice by the end of Fiscal Year 2014, if possible. These practices may take longer to implement due to procurement processes external to FEMS.
Strategic	Implement the practice within the two to three years. If possible, implement the practice sooner.

SECTION	BEST PRACTICE	PRIORITY
5.3.1	**Preventative Maintenance:** PM is a high priority for any fleet of any kind. In the fire/EMS business, PM is doubly important given that it is not possible to put out fires, rescue people, and bring sick and injured people to a hospital without functioning emergency vehicles. The absence of a PM program is a *severe* detriment to the fleet. Performing PM is less expensive than a "bust-and-fix" approach. PM increases the lifespan of a vehicle and reduces the time that the vehicle is unavailable for use.	**Essential**
5.3.2.1	**Strict Timekeeping**: The AD should issue and strictly enforce a policy on timekeeping. FASTER should be configured to capture time for a range of activities so that the AD leadership can better manage personnel and make more informed decisions about vehicle maintenance and replacement.	**Essential**
5.3.2.9	**Station-based Deficiency Reporting:** A station-based reporting capability creates greater accountability because an auditable record of the submission is created and can be used for performance measurement purposes.	**Essential**
5.3.2.3	**Performance Measures (KPIs):** Examples of the shortcomings previously identified include inconsistent data capture practices, limited data validation and accuracy verification processes, poor usage of reports to monitor activity or to enable informed management decisions, and a lack of Key Performance Indicators (KPIs) to evaluate, measure, or assess the operational effectiveness of the organization.	**Short-Term**
5.3.2.11	**Use of Synthetic Oil:** Synthetic motor oils perform (i.e., protect the engine) better than conventional oils and the intervals between changes can be extended. This is a crucial benefit, as the lack of a viable PM program causes FEMS apparatus to go significantly longer in between oil changes. Accordingly, using synthetic motor oils should be seen as a wise long term investment.	**Short-Term**
5.3.2.12	**Vehicle Fluid Testing**: Testing often identifies significant issues before major damage is done, which can become a significant part of PM and create significant savings for the fleet in the long term.	**Short-Term**
5.3.2.10	**Station-Based Repairs**: The department has many talented people working in fire stations, and many drivers are already very involved in the maintenance of their apparatus. This system needs to be encouraged and expanded upon.	**Short-Term**

SECTION	BEST PRACTICE	PRIORITY
5.3.2.13	**Customer Satisfaction Feedback Forms:** The feedback is used to improve operations and praiseworthy work is celebrated by posting the forms in a place where all can see them. This is a simple and inexpensive technique that will build positive relations from the AD's end customers while also providing the AD with information it needs to keep its customers happy.	Short-Term
5.3.2.14	**Best Practices Workgroup:** The Department should convene a Best Practices Working Group (BPWG) which would meet on a regular (e.g., monthly) basis to identify, evaluate, and recommend for adoption best practices in fleet management from other jurisdictions.	Short-Term
5.3.2.4	**Outsourcing Light Duty Vehicles**: Mechanics should be focused on heavy stock, not sedans and such. Light-duty vehicles, including cars, vans, and some SUVs, should be outsourced to other repair facilities.	Medium-Term
5.3.2.5	**Outsourcing Towing**: When a vehicle breaks down in the field and is unable to return to the shop under its own power, a mechanic is responsible for taking a tow truck out to retrieve the vehicle. This removes a mechanic from the shop floor. This task should be outsourced to a firm capable of towing any vehicle in the fleet. Reasonable timelines (90% compliance) should be involved in the contract with a towing company.	Medium-Term
5.3.2.6	**Outsourcing Parts:** It would be beneficial for FEMS to outsource the parts function even if the decision is made to retain other Shop functions in-house. Parts would not be billed to FEMS until they were used, although they would be available for use because the availability of parts would be contractually guaranteed by the vendor.	Medium-Term
5.3.2.8	**ZONAR Handheld Vehicle Checkout System**: Implementation of the ZONAR system in FEMS would convert the missed opportunity of morning checkouts into a means to funnel valuable information through FASTER to the AD. It will provide incontrovertible accountability between the performance of daily in-station vehicle inspections and the entry of work orders for the Shop.	Strategic
5.3.2.7	**Service-level agreements:** FEMS should explore possibilities to outsource maintenance and repair work on various portions of the fleet (i.e., light- and medium-duty vehicles) to partner agencies through the establishment of SLAs.	Strategic

APPENDIX V. SUMMARY OF FINDINGS

NO.	FINDING	SECTION
	SECTION 3 – FLEET DATA SYSTEMS	
1.	The support provided to FEMS by the DPW FASTER Support Team is inconsistent, and several unresolved issues remain.	3.1.2
2.	The majority of FEMS user accounts in FASTER are inactive, leading to inflated support and access costs.	3.1.2
3.	FASTER is underutilized across distributed workstations with respect to reporting or deriving performance indicators and work scheduling.	3.1.2
4.	The use of the mobile FASTER system by the mobile mechanic is inconsistent, and parts are not issued through the mobile terminal.	3.1.2
5.	Operational procedures and processes for effective use of FASTER system are incomplete, including a lack of consistent data capture standards and minimal use of management information.	3.1.2
6.	Staff lacks sufficient training in the FASTER application to make them thoroughly competent in its use.	3.1.2
7.	Staff does not "buy into" the effectiveness of FASTER and the benefits of its use (because they have not been properly trained and are unaware of many of its features/benefits).	3.1.2
8.	There is no central position responsible for FASTER system support, fleet data analysis, and management reporting.	3.1.2
9.	The count and composition of the physical inventory records listed in FASTER essentially reconciles with the physical inventory conducted by the Project Team of all FEMS fleet assets. The differences are relatively minor.	3.2.4
10.	Capitalization and projected replacement are not currently recorded for vehicle and asset management purposes, and disposal detail is not being consistently maintained.	3.2.4
11.	Advanced warranty notification capabilities are not currently configured for use, which is hampering procurement of adequate warranty service on apparatus.	3.2.4
12.	The FASTER graphics module is not being used. Asset records including descriptions of vehicle condition, accident related damage records, etc., are not supported by vehicles images and other graphics, and could be with the current software functionality.	3.2.4
13.	The simplified in-house vehicle classification system used by FEMS limits the ability to do more detailed comparison and analysis.	3.2.4
14.	Vehicle classification status in place at FEMS is not consistent and comprises a combination of the previous user-defined class codes and the new NAFA codes.	3.2.4
15.	FEMS has not identified and/or does not operate in accordance with a universally adopted set of organizational SOPs for fleet management. A lack of SOPs has caused notable inefficiencies, inconsistencies, conflicting management operation.	3.3.5

NO.	FINDING	SECTION
16.	Continual process improvement has not been made a priority and as a result, several business processes are outdated or ineffective and need to be evaluated and redeveloped to leverage industry best practices and incorporate the use of fleet management information technology.	3.3.5
17.	Cumbersome processes for managing workflow in FASTER for in-house and commercial repairs are slowing work order management.	3.3.5
18.	Tight work order security settings are hindering the ability of service writers to close work orders, resulting in extended open repair transaction times, the inability to properly defer repairs (in some cases), and even the deletion of required repairs from work orders without that work being completed.	3.3.5
19.	Data captured within work orders is of overall poor and inconsistent quality and quantity due to inconsistent coding, data capture methods, and noting of labor performed.	3.3.5
20.	Vehicle downtime calculations are suspected to be understated as a result of the methodology for reporting fleet availability as opposed to downtime.	3.3.5
21.	The FASTER Service Center function is not currently being used by staff or FEMS customers and the benefits of the tool are not acknowledged.	3.3.5
22.	Excessive detail and inappropriate work codes (nearly 8,500 distinct repair codes) available for entry on work orders is suspected to be reducing the accuracy of activity tracking and adding unnecessary complexity to management reporting rather than increasing the detail recorded.	3.3.5
23.	Repair coding for mobile services does not separate scheduled maintenance from breakdowns and, therefore, cannot be used as a key performance indicator.	3.3.5
24.	FASTER is not currently being used for parts inventory and parts processing, including ordering, stocking, and parts movement. No apparent standard operating procedure, secure process, or consistent procedure is in place for any aspect of parts management.	3.3.5
25.	FEMS' current product, FASTER C/S, provides the majority of requirements that FEMS has determined are critical to the operation, although several concerns must still be addressed, including current system utilization, in order to derive maximum benefit from the application.	3.4.10
26.	There are issues with the deployment of FASTER C/S that should be considered/resolved making a decision about whether to procure a new system or to retool the existing operational processes and procedures for using FASTER.	3.4.10
27.	A hosted solution offers many benefits, including improved affordability, speed, accessibility, security, and support.	3.4.10
	SECTION 4 – FLEET COMPOSITION	
28.	The physical inventory revealed an aging fleet in generally unacceptable condition. While newer frontline engine and truck companies tend to be in acceptable condition, older units are only in passable condition. Reserve engine and truck companies are barely in passable condition. The condition of the frontline squads is not a concern, but the reserve squad fleet is in barely passable condition.	4.1.3

NO.	FINDING	SECTION
29.	Apparatus is overworked while in frontline and reserve status. Vehicles are on the road virtually non-stop. Despite a desperate need for PM and repairs, they continue to be driven as their physical and engine conditions worsen.	4.1.3
30.	Reserve apparatus is worked as hard as frontline apparatus because so much frontline apparatus is out of service for various reasons. The reserve apparatus is badly worn by the time it becomes reserve apparatus. This, combined with the level of use of the reserve apparatus, contributes to a high failure rate and an ever-deteriorating reserve fleet.	4.1.3
31.	The older EMS transport vehicles (i.e., the Ford ambulances) are in terrible condition. The Ford ambulances create a huge demand on the Shop for repair services and take longer to maintain and repair than the International Harvesters. By contrast, the newer EMS transport vehicles (i.e., the International Harvesters) are almost all in Excellent or Very Good shape, but this is mainly a function of their newness. If they do not receive appropriate PM, they will wind up in the same shape as the current fleet of Ford ambulances within a few years.	4.1.3
32.	Life cycle costing is a potentially valuable tool for FEMS to employ in making decisions about what apparatus to purchase and when apparatus should be removed from the fleet.	4.2.2
33.	The lack of needed high-quality vehicle cost data makes it impossible to perform life cycle cost analysis on the FEMS fleet.	4.2.2
34.	The condition of the reserve fleet is inadequate to support a heavily used frontline fleet.	4.3.8
35.	Keeping a Ready Reserve fleet stocked and ready to roll reduces the need for companies to do a “change-over” to accommodate PM.	4.3.8
36.	Annual procurement of all types of FEMS apparatus has been extremely uneven since at least year 2000.	4.3.8
37.	FEMS is behind schedule on the purchasing of 10 engines, three trucks, and two squads over the last 14 years. FEMS is also behind schedule on the purchasing of seven ambulances over the last 7 years.	4.3.8
38.	Peaks and valleys in fleet replenishment create problems in terms of apparatus condition and demands on the Shop for maintaining and repairing existing apparatus as well as placing new apparatus in service and retiring old apparatus.	4.3.8
39.	Uneven procurement stresses the FEMS capital budget, making it more difficult to do long-term financial planning and subjecting larger capital budget request to trimming.	4.3.8
40.	There is a trend in the fire service toward maintaining a younger fleet.	4.4.4
41.	A replacement plan that calls for engines to remain in frontline service for 15 years or more is not in FEMS’ best interest.	4.4.4
42.	Deferred replacement of apparatus places unnecessary strain on fleet operations and fleet maintenance requirements.	4.4.4

NO.	FINDING	SECTION
	SECTION 5 – APPARATUS DIVISION OPERATIONS	
43.	The current organizational structure of the AD is one of the main barriers to effective fleet management system in FEMS.	5.2.1.5
44.	A fleet industry professional is needed to lead and oversee the implementation of new procedures, processes, and systems in the AD. The AD's current organizational structure fosters discontinuity in the AD's programs and effectiveness because the AD leadership is always changing.	5.2.1.5
45.	Data collected by FEMS through FASTER does not accurately reflect hours worked by FEMS mechanics or outside vendors.	5.2.2.2
46.	With 15 mechanics, the Shop is understaffed for the present demand for maintenance and repair services. Once needed improvements are made to the fleet inventory and the Shop is running more efficiently, 14 mechanics should suffice.	5.2.2.2
47.	As discussed in Section 3, fleet management information systems, the lack of available data is a *significant* issue for FEMS management. It is impossible to identify needed staffing levels accurately when one cannot track hours worked by existing staff or the amount of work conducted by vendors.	5.2.2.2
48.	No identifiable performance expectations have been communicated to Shop personnel.	5.2.3.1
49.	Shop personnel are not keeping accurate track of their time in FASTER.	5.2.3.1
50.	Shop personnel are not routinely held accountable for either the timeliness or quality of their work.	5.2.3.1
51.	AD managers are not routinely using FASTER to monitor the productivity and performance of the Shop.	5.2.3.1
52.	Keeping the Shop open on a 24/7 basis does not improve Shop throughput.	5.2.4.2
53.	Mechanics working the night shift do not receive adequate supervision or support.	5.2.4.2
54.	Mechanics working the night shift frequently work alone – a dangerous practice.	5.2.4.2
55.	Pulling mechanics from the Shop floor to provide road service interferes with maintenance and repair operations.	5.2.4.2
56.	Outsourcing represents a faster and more comprehensive means to afford the AD the expertise, professionalism, and quality performance it so urgently needs.	5.2.5.4
57.	Outsourcing of light- and medium-duty vehicles is a viable means to decrease the AD workload and to keep the Shop focused on providing services that are mission-critical and more difficult to obtain elsewhere.	5.2.5.4
58.	There are other fleet operations in D.C. Government and the region with which FEMS could establish an SLA to perform certain repairs.	5.2.5.4
59.	There are no records about mechanics' training or certifications.	5.2.6.4
60.	Shop personnel are hungry for training.	5.2.6.4

NO.	FINDING	SECTION
61.	There is little encouragement or assistance given to Shop personnel to pursue professional training and continuing education.	5.2.6.4
62.	There is little emphasis placed on mechanics obtaining nationally recognized certifications, such as ASE or EVT.	5.2.6.4
63.	Training on FASTER has been inadequate.	5.2.6.4
64.	Esprit de corps among Shop personnel can be considered strong, although morale remains lower than it should be.	5.2.7.1
65.	Poor working conditions and depressing physical surroundings contribute to demoralization.	5.2.7.1
66.	Lack of emphasis on the FEMS mission and vision along with varied levels of training and team spirit has resulted in an uneven sense of purpose and morale.	5.2.7.1
67.	Basic safety practices are not in evidence at the FEMS Shop.	5.2.8.1
68.	FEMS does not require apparatus operators or technicians to pass an EVOC course as part of their driver training program.	5.2.9.1
69.	Apparatus technicians are not formally trained in the operation, inspection, and basic in-station maintenance of apparatus.	5.2.9.1
70.	The absence of a PM program is a *severe* detriment to the FEMS fleet. PM saves money, keeps apparatus in service in the community more, and ensures lengthens the expected service life of apparatus.	5.3.1.4
71.	The mobile servicing of apparatus currently being performed should not be confused with, nor should it take the place of, a real PM program.	5.3.1.4
72.	Having a viable Ready Reserve fleet is a key factor in the success of a PM program.	5.3.1.4
73.	There are numerous best practices that could be implemented in the AD and throughout FEMS that would improve the operations of the AD.	5.3.2.15
74.	Management of the parts inventory is poor.	5.3.3.1
75.	FEMS does not have sufficient personnel for the effective and efficient operation of a small tools repair shop for a fire/EMS department of this size, based on the workload and workforce currently in place.	5.3.4.2
76.	Crucial small tool repairs and critical pump testing requirements are languishing behind schedule due to a lack of a dedicated full-time (or even part-time repair) program and repair person.	5.3.4.2
77.	The current schedule of small tool repairs and the lack of a dedicated maintenance and repair program has created and perpetuated a critical and inefficient backlog of small tool repairs and out-of-service equipment.	5.3.4.2
78.	Ground ladder safety has been compromised by the lack of and commitment to a dedicated repair and maintenance program in the Small Tools Section.	5.3.4.2
79.	Critical pump testing has not occurred for 3 years.	5.3.4.2
80.	FEMS uses gasoline with ethanol in small tools, which can damage small engines.	5.3.4.2

NO.	FINDING	SECTION
81.	Change-overs are laborious, tiring, and time-consuming. During change-overs units are unavailable in the communities which they serve.	5.3.5.2
82.	FEMS personnel are called upon to change-over units on a frequent basis – sometimes multiple times per day.	5.3.5.2
83.	Vehicles make unnecessary and long trips to the Logistics facility on V Street, NE to be restocked.	5.3.5.2
84.	There is no appreciable QC program in place within the AD.	5.3.6.1
85.	There is a considerable amount of rework done on repairs made on FEMS apparatus – far in excess of industry norms.	5.3.6.1
86.	The repair facility is not adequate for working on modern fire apparatus.	5.4.1.4
87.	There is no dedicated floor space for preventative maintenance.	5.4.1.4
88.	The Shop is overcrowded with apparatus, and sightlines are virtually non-existent.	5.4.1.4
89.	The low ceiling height impairs the ability to lift units for inspection/repair and to elevate aerial devices.	5.4.1.4
90.	The lack of an in-ground lift adds to time needed to effect many repairs.	5.4.2.1
91.	The lifts in the ambulance PM area (in the rear of the shop) are not powerful enough to life the new International Harvester ambulances.	5.4.2.1
92.	Based on the size of the reserve fleet, approximately 18,000 square feet of covered storage is needed to for reserve apparatus.	5.4.4.1
93.	The AD has no fleet management SOPs or handbook which specifically governs the non-uniformed foreman, mechanics, ticket writers, dedicated PM schedules or procedures, and Shop operations.	5.5.2
94.	There is no written mechanism within the organizational structure, procedurally or otherwise, which systematically addresses work that is in the process of being done or work that is to be done.	5.5.2
95.	The short contract term of current FEMS apparatus procurements works against FEMS' best interest. Vendors would have considerably more incentive to offer better prices and service if were offering longer-term apparatus contracts.	5.6.6
96.	Awarding apparatus contracts based solely on price is not in the best interest of FEMS. "Best-value" awards offer FEMS the flexibility to consider additional factors which are every bit as important as price.	5.6.6
97.	There are differing opinions as to the level of participation of FEMS mechanics on the Apparatus Committee. Mechanics can offer substantial insight in the development of apparatus specifications and thus fill an important role on the Committee.	5.6.6
98.	Standardizing apparatus by class across the fleet offers FEMS substantial operational, financial, and maintenance efficiencies and benefits.	5.6.6

NO.	FINDING	SECTION
99.	The small apparatus bays of some older FEMS stations limit the size of the apparatus that can be placed there. Obtaining maximum flexibility in what apparatus can be used – either in frontline or reserve status – in those stations requires that apparatus be standardized to fit in the smallest station.	5.6.6
100.	FEMS could most likely procure commercial apparatus that is sized to fit FEMS stations and which will cost substantially less than custom apparatus.	5.6.6
101.	Apparatus factory visits are crucial to the procurement process and should not be viewed as optional.	5.6.6
102.	GSA can perform apparatus procurement on behalf of OCP and FEMS.	5.6.6
103.	Engine placement and access in the Ford ambulances hampers the ability of the Shop to maintain and repair these units. In contrast, engine placement and access in the International Harvester ambulances facilitates maintenance and repair.	5.6.6
104.	Numerous ambulances were noted to have inoperable air conditioning on some of the hottest days of the summer. Patient compartment temperatures were unhealthful for patients and EMS personnel alike.	5.6.6
105.	Emergency lighting systems that are compliant with the KKK-A-1822F ambulance procurement specification may not offer sufficient protection in a heavily urbanized environment with lots of intersections.	5.6.6
	SECTION 6 – STATION-BASED OPERATIONS	
106.	Required daily vehicle checkouts are not being performed consistently and well across the FEMS enterprise. There is no accountability or QC built into the checkout process.	6.1.1
107.	The results of vehicle checkouts cannot be analyzed because checkout results are not recorded electronically.	6.1.1
108.	Deficiencies found during the checkout process must be manually reported to the AD.	6.1.1
109.	The current system of e-mailing the AD (and others) about needed repairs allows too many repair requests to "slip through the cracks" and it does not permit such requests to be time-stamped and entered into an auditable system which ensures accountability for the disposition of such requests.	6.2.1
110.	Article XX's requirement that seven people be notified via e-mail of every repair request is a legacy of an ineffective vehicle deficiency notification system.	6.2.1
111.	A properly trained apparatus operator (i.e., technician) should be able to accomplish a variety of routine, simple in-station maintenance and repairs. Doing so eliminates the need to bring the apparatus in to the Shop, resulting in the unit staying in service in the community longer and reducing the demand for service at the Shop.	6.3.2
112.	Numerous failures of Vogel Lube Systems endanger the serviceability of apparatus.	6.3.2

APPENDIX VI. SUMMARY OF RECOMMENDATIONS

NO.	RECOMMENDATION	SECTION
	SECTION 3 – FLEET DATA SYSTEMS	
1.	Establish system support requirements and options, and determine the best method by which FEMS can achieve proper network and FMIS support; secure an SLA for support, if applicable.	3.1.3
2.	Perform system maintenance to identify active and obsolete user accounts, negotiating proper system charge levels based on active user accounts;	3.1.3
3.	Identify best practice information management, management reporting and performance indicators.	3.1.3
4.	Analyze the processes and procedures required to provide the data needed to generate the intended result.	3.1.3
5.	Take steps to provide remedial data normalization for existing inconsistencies, institute policies, procedures and user training to implement any changes needed to safeguard proper data management procedures.	3.1.3
6.	Provide fleet management and FMIS system training matching business processes to FMIS system.	3.1.3
7.	Establish a fleet IT analyst position, or identify a FEMS IT resource capable of providing fleet analytics and reporting assistance.	3.1.3
8.	Reconcile the physical inventory with the assets listed in FASTER.	3.1.2
9.	Utilize FMIS to track attributes, assignments and locations of all vehicles enabling all fleet users to monitor real-time details and statuses.	3.2.5
10.	Review all codification and applicable asset descriptors, groupings and distribution to ensure optimal system configuration to support asset management, reporting and analysis.	3.2.5
11.	Record manufacturers and extended vehicle and component warranties, and enable automated warranty tracking to interactively notify the service writer, crew leader, or mechanic when a warranted system is about to be repaired.	3.2.5
12.	Use the FASTER graphics module to store pictures, diagrams, invoices, purchase documents, etc. for use in supporting vehicle asset records, vehicle condition, specialty equipment placement and/or accident related damage records.	3.2.5
13.	Employ a more consistent and detailed vehicle classification system to allow comparison and analysis of like grouping regardless of make and model of vehicle.	3.2.5
14.	Reevaluate and redevelop current business processes that are outdated and ineffective by leveraging industry best practices while maximizing the use of available fleet management information technology.	3.3.6
15.	Map individual organizational work processes to include the use of a fully capable FMIS to manage the individual work procedures.	3.3.6

NO.	RECOMMENDATION	SECTION
16.	Correct repair deferral and closing function to avoid unintended deletion of open repairs from the work order during the closing process and to enable deferred repair tracking.	3.3.6
17.	Modify the existing database trigger to restrict the inclusion of the walk-around inspection to only the maintenance shops that require that entry.	3.3.6
18.	Redesign and restructure coded data elements used for assigned repairs and resulting labor transactions on work orders to ensure enough detail is available for follow up review and historical analysis without being burdensome on users.	3.3.6
19.	Analyze the benefit of reporting measurement of downtime/availability versus simple measurement and reporting of true time a work order is classified as "active," to determine whether there are specific advantages of either reporting system that may lend to more accurate analysis.	3.3.6
20.	Utilize FASTER Service Center to better report vehicle deficiencies to the AD and to provide departments with visibility of work history and current work order activity.	3.3.6
21.	Revise repair coding to support the activities of the maintenance and repair organization and the level of detail required for effective management reporting.	3.3.6
22.	Utilize a different repair reason for road service (i.e., scheduled repair) versus road calls (i.e., breakdown) provided by mobile services to more effectively measure KPIs for work performed by mobile service mechanics.	3.3.6
23.	Designate a separate work order shop and storeroom identifier for mobile service vehicles to ensure efficient monitoring of the operations of each of the mobile service vehicles and to facilitate direct comparison with in-house facilities.	3.3.6
24.	Utilize the bar code functionality in FASTER to issue parts to work orders.	3.3.6
25.	Develop and conduct fleet management training in conjunction with FMIS training to promote staff buy-in to ensure improved information management, including reporting, data capturing and monitoring, and analysis.	3.3.6
26.	System upgrades required by DPW and the timing for needed fleet management and FMIS training should be considered when determining the most appropriate FMIS path for FEMS.	3.4.11
27.	Determine whether to procure a new system or to retool the existing operational processes and procedures currently in place using the FASTER system.	3.4.11
	If FEMS chooses to continue using the existing FASTER system:	
28.	Better utilize functions offered by the FASTER system, as described within specific recommendations in Sections 3.2.5 and 3.3.6.	3.4.11
29.	Systematically work to address constraints found within FASTER as currently deployed.	3.4.11
30.	Address the core deficiency issues shown as "N" or "P" in Table 17.	3.4.11

NO.	RECOMMENDATION	SECTION
	If FEMS chooses to procure a new system:	
31.	FEMS must consider initial cost, ongoing cost, ability to meet requirements, ease of acquisition, and training and support, when considering COTS applications	3.4.11
	When implementing a new system:	
32.	Ensure successful implementation by developing a comprehensive tailored implementation plan and extensive services and training.	3.4.11
33.	Apply new system with attention to configuration and process engineering that will provide a solid baseline for a successful transition and enable effective and efficient data collection, analysis, and reporting technologies.	3.4.11
34.	Select and implement technology solutions to fill existing procedural gaps integrating these tools with the FMIS to provide a single reporting and management platform.	3.4.11
	SECTION 4 – FLEET COMPOSITION	
35.	All apparatus should receive regularly scheduled PM *on time and without fail*.	4.1.4
36.	The apparatus replacement plan should be funded and adhered to *without fail*.	4.1.4
37.	Get rid of current Ford ambulances in order to free up Shop labor. Where the patient compartments (i.e., "ambulance boxes") are still in good condition, they should be refurbished and remounted on new chassis in order to lower costs.	4.1.4
38.	Complete and accurate vehicle cost data should be gathered and examined at least annually for each apparatus class including engines, ladder trucks/towers, heavy duty rescue, ambulances, and refurbished ambulances in order to develop and analyze a dataset to track vehicle depreciation versus operation and maintenance costs each year.	4.2.3
39.	Configure reserve apparatus fleet by reserve and ready reserve fleets. A reserve fleet of approximately 50% of the ready reserve fleet size is recommended because of the heavy usage and frequent failures of frontline vehicles.	4.3.9
40.	Ready Reserve vehicles should be fully stocked, in top condition, with lowest mileage coming off of frontline duty.	4.3.9
41.	Reserve ambulance fleet should include a Special Events Unit, which should be maintained as ready-to-roll units.	4.3.9
42.	Engine fleet should include a Water Supply Unit, specifically designed to handle water supply issues at major fire incidents.	4.3.9
43.	Finalize and adhere to an apparatus replacement schedule (see Section 4.4.2) to ensure a continual flow of units through frontline, ready reserve, and reserve status.	4.3.9
44.	Work to educate the D.C. Council and the Office of the Chief Financial Officer about the need to adhere to a strict procurement schedule so that short-term cost savings are not obtained at the expense of long-term problems in the fleet.	4.3.9
45.	New apparatus should be budgeted for and procured on a consistent, on-going basis. Replacement of apparatus should not be deferred because of the strain that such actions place on the fleet.	4.4.5

NO.	RECOMMENDATION	SECTION
46.	Apparatus that is unexpectedly lost in a catastrophic event (e.g., crash or fire) should be replaced on an expedited basis. The reserve fleet should be used as little as possible to backfill apparatus lost in these circumstances.	4.4.5
47.	Apparatus should not be rotated from high-volume to low-volume stations.	4.4.5
48.	Adhere to the replacement schedule outlined in Section 4.4.2.	
	SECTION 5 – APPARATUS DIVISION OPERATIONS	
49.	FEMS should hire a professional, civilian Fleet Director with relevant qualifications to head the AD.	5.2.1.6
50.	The Fleet Director should report directly to the Fire Chief, not the Assistant Chief of Administrative Services. This direct reporting line will be particularly important in ensuring the AD's transition to becoming a more efficient organization.	5.2.1.6
51.	The AD should be restructured, as described in Section 5.2.1.4. New position descriptions should be developed to support realigned and newly created positions.	5.2.1.6
52.	Mechanics must accurately log the time they spend on each repair. This may require additional training on the proper use of the FASTER system to log repairs at the time they are performed.	5.2.2.3
53.	Hire four additional mechanics to fill the immediate gap in Shop's ability to meet the demand for service. As improvements are made to the FEMS fleet and the AD operations, the number of mechanics should be allowed to float down to 14 through natural attrition.	5.2.2.3
54.	Management-based performance metrics should be established for Shop personnel. Such metrics would provide a framework for developing performance goals and for measuring personnel performance.	5.2.3.2
55.	AD managers should be using FASTER on a daily basis to monitor the productivity and performance of the Shop.	5.2.3.2
56.	Managers must hold mechanics accountable for the timeliness and quality of their work. In addition to developing and deploying performance metrics, it is important that standard operating procedures for continuous monitoring and feedback are developed.	5.2.3.2
57.	Training on proper use of FASTER to track time must be delivered.	5.2.3.2
58.	QC checks should be performed on all work at the time of completion. Work that fails to meet quality expectations should be corrected.	5.2.3.2
59.	Terminate night and weekend shifts, and reassign the workers on the night shift to the day and evening shifts.	5.2.4.3
60.	Assign one foreman on each shift to lead repair operations and the second foreman to lead PM.	5.2.4.3
61.	FEMS should undertake a feasibility study of the use of a contracted fleet management system similar to the one in use in MPD.	5.2.5.5

NO.	RECOMMENDATION	SECTION
62.	If the decision is made not to contract out all Shop services, then FEMS should explore other opportunities to contract out for services, including for light- and medium-duty vehicles, towing, and parts supply.	5.2.5.5
63.	The AD should establish as a minimum standard of employment for all current and future mechanics to obtain ASE and EVT certification. An additional requirement should be established that all subsequent promotions of personnel to the foreman level must have, or obtain within a prescribed timeframe, both the ASE Master Technician and Master EVT certifications.	5.2.5.5
64.	The AD should immediately update its records on each mechanic and foreman with respect to training obtained, current certifications possessed, and any needed professional development/continuing education.	5.2.6.5
65.	The AD should use the Target Safety application to track the training and certifications of Shop personnel. Additionally, the AD should explore how Target Safety may be used to deliver relevant continuing education programs to its Shop personnel.	5.2.6.5
66.	Professional Development Plans for all Shop employees should discuss professional standards for productivity and include means for AD personnel to improve their knowledge, skills, and abilities.	5.2.6.5
67.	The AD should create incentives (e.g., tuition reimbursement and pay adjustments) for fleet supervisors and managers to secure certifications from ASE, EVT, American Public Works Association, Association of Equipment Management Professionals, NAFA Fleet Management Association, or other suitable industry associations.	5.2.6.5
68.	The AD should budget for a minimum of 40 hours of technical training per employee annually.	5.2.6.5
69.	The AD should explore the availability of local and in-house training opportunities.	5.2.6.5
70.	The AD should establish an updated and comprehensive training program on the importance of FASTER, its use, why information should be captured, what data should be tracked, and why data are essential to the success of the AD.	5.2.6.5
71.	FEMS should improve the working conditions at the Shop, by making a concerted effort to improve environmental conditions and by taking steps to ensure that all employees are aware of and embrace the FEMS mission, vision, goals and objectives. This could be achieved through targeted training and team building activities.	5.2.7.2
72.	AD leadership should take steps to ensure that the organization takes a mission driven approach to running its operations. This is particularly important as it relates to line level operations and would be a key consideration when developing and codifying standard operating procedures.	5.2.7.2
73.	FEMS should promulgate and closely enforce a policy on Shop safety. This policy should comport with industry standard practices, applicable portions of NFPA 1500 (Standard on Fire Department Occupational Safety and Health Program), and applicable OSHA regulations.	5.2.8.2

NO.	RECOMMENDATION	SECTION
74.	FEMS should ensure that all Shop personnel are issued a complete set of appropriate personal protective equipment and that a sufficient quantity of replacement equipment and disposable items are maintained continuously on hand to ensure that all Shop personnel and visitors are adequately protected at all times when on the Shop floor.	5.2.8.2
75.	Shop personnel should receive regular safety training and updates in accordance with OSHA guidelines and commonly accepted industry practices. This includes any specialized training required to operate lifts, cutting or welding equipment, tow trucks/wreckers, or any other vehicles and/or equipment Shop personnel may be called upon to operate.	5.2.8.2
76.	No one should be permitted to work alone in the Shop at any time.	5.2.8.2
77.	FEMS should implement formal EVOC training for anyone who will operate any emergency apparatus.	5.2.9.2
78.	FEMS should implement a formal technician training program for all technicians. This training should include the vehicle inspection and deficiency reporting process, as well as how the apparatus should be maintained in the station and operated on the road.	5.2.9.2
79.	FEMS should consider authorizing in-station personnel to effect simple repairs such as changing burned-out light bulbs in simple applications found on apparatus. This should not involve the repair of the fixtures themselves, nor include the repair or tampering with any wires connected with those appliances, but minor maintenance tasks only.	5.2.9.2
80.	Implementation of a comprehensive PM program in accordance with NFPA 1915 ***must*** be made a ***top*** priority. This point cannot be overstressed.	5.3.1.5
81.	FEMS policy should ensure that apparatus is taken to the Shop for PM when it is scheduled, without fail.	5.3.1.5
82.	PM triggers should be expressed for each class of apparatus (and, in some cases, each vehicle model) and should reflect mileage, engine hours, age of the apparatus, etc., not just the number of days since the last PM.	5.3.2.16
83.	The AD should issue and strictly enforce a policy on timekeeping. FASTER should be configured to capture time for a range of activities so that the AD leadership can better manage personnel and make more informed decisions about vehicle maintenance and replacement.	5.3.2.16
84.	The AD needs to develop both system- and individual-level KPIs which are disseminated in daily, weekly, and monthly reports. AD and FEMS leadership should review relevant KPIs daily so they can stay on top of managing the fleet.	5.3.2.16
85.	FEMS should explore the full range of possible outsourcing options, including contracting for all fleet management services or contracting for services for a portion of the AD workload, including towing, parts management, and/or light- and medium-duty apparatus. Establishment of SLAs with partner agencies should also be considered.	5.3.2.16

NO.	RECOMMENDATION	SECTION
86.	FEMS should implement a ZONAR pilot program in one or two stations to test the utility of the system to improve vehicle checkout accountability and deficiency logging/work order creation (see Section 6.1).	5.3.2.16
87.	The AD should implement the FASTER Service Center or some other means to permit in-station reporting of deficiencies (see Section 6.2).	5.3.2.16
88.	FEMS should permit trained technicians to effect certain authorized maintenance and repairs in stations (see Section 6.3).	5.3.2.16
89.	The AD should use synthetic oil in all apparatus, especially since the time between oil changes can be so great at present.	5.3.2.16
90.	The AD should regularly test vehicle fluids to identify contaminants that are indicators of pending engine problems.	5.3.2.16
91.	The AD should implement a system to ensure that end users can provide feedback on the quality of services delivered in connection with maintenance and requested repairs.	5.3.2.16
92.	The AD should implement a BPWG to identify, evaluate, and implement novel best practices from other jurisdictions.	5.3.2.16
93.	Hire a parts inventory specialist as soon as possible, if it is decided not to contract out the parts function.	5.3.3.2
94.	FEMS should obtain a full-time small tools repair technician to address the crucial backlog of tool repairs and pump and ladder testing. If the position is to be filled on a part-time basis, it should be *substantially* more than 12 hours per month. This position could be an outsourced FTE which is part of an overall contract with a Shop vendor.	5.3.4.3
95.	FEMS should immediately reinstate and adhere to a pump testing program which meets the requirements of NFPA 1911 (Standard for the Inspection, Maintenance, Testing, and Retirement of In-service Automotive Fire Apparatus).	5.3.4.3
96.	FEMS should immediately reinstate and adhere to a ground ladder inspection and testing program which meets the requirements of NFPA 1932 (Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders).	5.3.4.3
97.	FEMS should use a fuel treatment designed to minimize damage to small tool engines from ethanol in gasoline.	5.3.4.3
98.	FEMS should seek ways to keep reserve units partially stocked with low-cost equipment and should consider buying extra hose to keep the hosebeds of engine companies from having to be restocked.	5.3.5.3
99.	The AD should lift the prohibition of conducting change-overs indoors if a new Shop with a suitable amount of space can be constructed.	5.3.5.3
100.	A “mini-Logistics” facility should be co-located with the Shop so that vehicles can be returned to service fully stocked without having to leave the Shop.	5.3.5.3

NO.	RECOMMENDATION	SECTION
101.	A qualified QC Specialist should be hired by FEMS (see Section 5.2.5). If the decision is made to contract out Shop operations, then this person should not be a contractor (or, at the very least, should not be part of an overall Shop management contract), as one of the key responsibilities of this individual will be to examine the quality of work performed by the contractor's mechanics.	5.3.6.2
102.	Ensure every PM and repair undergoes a QC check. Work that is unsatisfactory must be corrected before the work order is closed and the vehicle leaves the facility.	5.3.6.2
103.	Personnel dispatched to Shop vendors to retrieve vehicles that are "ready" must be able to perform QC checks at the vendors' facilities so that inadequate repairs are identified as such before the vehicle is accepted by FEMS.	5.3.6.2
104.	QC metrics should be collected and analyzed for every mechanic. This will permit the AD leadership to ensure that mechanics are meeting quality expectations. It will also permit the identification of trends that could necessitate remedial training or other appropriate mitigation measures.	5.3.6.2
105.	QC metrics should be collected and analyzed for each vehicle. This will aid the AD leadership in evaluating the continued roadworthiness of the apparatus and whether apparatus has outlived its useful service life.	5.3.6.2
106.	Replace the Shop with a structure designed for current and future fire apparatus. This would require detailed space planning based on the acquisition schedule and projected increases in apparatus and should consider the need to move apparatus in and out of the facility on an ongoing basis and the frequency and types of repairs.	5.4.1.5
107.	Dedicated PM bays should be viewed as an essential part of the design of a new shop facility. Given the recommended size and composition of the fleet, at least one bay for heavy-duty apparatus PM, two bays for ambulance PM, and one bay for light-duty PM should be included in the design.	5.4.1.5
108.	Ensure that any new shop facility is equipped with at least one in-ground lift.	5.4.2.2
109.	Procure mobile lifts that are sufficiently powerful to lift the International Harvester ambulances.	5.4.2.2
110.	Procure – either through construction or leasing – approximately 18,000 of suitable, covered space in which to store reserve apparatus.	5.4.4.2
111.	Store the minimum amount of Ready Reserve apparatus possible at the Shop.	5.4.4.2
112.	Develop and maintain a comprehensive AD Policy and Procedures Manual which governs all aspect of the AD including management practices, employee evaluations, Shop operations, performance measures, dedicated PM schedules, etc. (see Section 5.5).	5.5.3
113.	A wide cross-section of stakeholders should collaborate to develop the Policy and Procedures Manual that covers the topics listed in APPENDIX I	5.5.3

NO.	RECOMMENDATION	SECTION
114.	The District should issue apparatus contracts for extended periods – between 5 and 8 years in order to incentivize vendors to offer FEMS more in terms of price, warranty conditions, technical support and training for mechanics and field personnel, and willingness to accommodate FEMS' special requests and specifications.	5.6.7
115.	FEMS should utilize "best-value" rather than "lowest bid" contract awards.	5.6.7
116.	The AD should ensure that mechanics, not just foremen, are actively involved in all aspects of the Committee's work, including specifications development and apparatus acceptance.	5.6.7
117.	FEMS should seek to standardize apparatus types across the fleet whenever possible.	5.6.7
118.	FEMS should endeavor to order commercial apparatus whenever possible.	5.6.7
119.	The most qualified members of the Apparatus Committee – irrespective of rank – should perform these factory visits.	5.6.7
120.	Consideration should be given to having GSA procure apparatus for FEMS.	5.6.7
121.	Ease of maintenance should a factor to be considered when evaluating ambulance designs and vendor bid submissions.	5.6.7
122.	A working climate control system should be regarded as mandatory on all in-service ambulances. Any ambulance which loses climate control should be taken out of service.	5.6.7
123.	FEMS should give strong consideration to procuring ambulances equipped with the Cool-Tech II air conditioning system, or some other system that offers similar advantages with respect to heat dissipation, cooling capacity, and ease of maintenance.	5.6.7
124.	Ambulances should be equipped with grill-mounted flashing lights to enhance their conspicuity in rear-view mirrors and with lighting that makes them more visible perpendicular to the direction of travel.	5.6.7
	SECTION 6 – STATION-BASED OPERATIONS	
125.	Implement the ZONAR system on a pilot basis (one or two stations) to establish a proof of concept. If the pilot is successful, FEMS should expand the program to the whole FEMS emergency fleet.	6.1.2
126.	FEMS should change Section 25 of Article XX to require vehicle deficiency notifications and repair requests to be entered into FASTER (or a similar application) at the station level, in lieu of the current e-mail system.	6.2.2

NO.	RECOMMENDATION	SECTION
127.	FEMS should amend Article XX Section 22 and Special Order 2013-25 to include permit qualified station personnel to perform simple repairs and minor maintenance tasks, such as changing burned out light bulbs. Authorized in-station repairs should not include anything associated with sophisticated electronics systems (i.e., communications equipment, on-board computers, emergency lighting or siren system) or engine components (other than topping off fluid levels).	6.3.3
128.	All technicians should receive in-depth training from the AD about the types of repairs they are expected and authorized to undertake in the station. No repairs should be authorized by personnel who have not received training to make them.	6.3.3
129.	All Vogel Lube Systems should be inspected, restored to working condition (if necessary), and maintained in accordance with manufacturer's specifications.	6.3.3