EXPLORING STRATEGIES FOR VEHICLE MAINTENANCE COST REDUCTION/COST CONTAINMENT IN THE MADISION TOWNSHIP FIRE DEPARTMENT

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CERTIFICATION STATEMENT

I hereby certify that the following statements are true:

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ABSTRACT

The Madison Township Trustees have expressed a desire to operate more efficiently, therefore the department heads must look at ways of reducing operational costs.

The problem this research paper addressed was the fire department's lack of sufficient information to suggest how cost savings might best be accomplished. The purpose of this study was to recommend an effective way to achieve vehicle maintenance in a cost effective manner.

Descriptive research was conducted to answer the following questions:

1. What are the Madison Township Fire Department's (MTFD) current vehicle maintenance practices and costs?
2. Do skill levels of maintenance personnel vary for these services?
3. What are current vehicle maintenance practices and costs of other departments comparable in size and run volumes?
4. How does MTFD compare to surrounding departments on vehicle maintenance practices and costs?

The procedures used were descriptive surveys e-mailed to local departments combined with interviews, and a literature review. The interviews revealed the different approaches these departments take and the areas where they are seeing the benefits.

Results compiled by this research paper indicate the need for the department to develop a more comprehensive data management system to improve data collection for analysis and forecasting. While other departments believe they achieve savings they are not able to document them. Future researchers can build on these results to aid in their research of a similar problem.

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INTRODUCTION

Statement of the Problem

The Madison Township administration has established "efficiency and effectiveness" as a goal for 2010 and beyond. Reducing the cost of vehicle maintenance has been identified as an operational area that can yield cost savings by reducing the charges for mechanic services. *The problem that this study addressed was* that the department lacked sufficient information to suggest how cost savings might best be accomplished. While data on past operational costs were available, no thorough analysis of the operational practices, costs and potential future options exists to support a plan for cost reduction.

The Madison Township Fire Department has employed various different methods to perform vehicle maintenance, evolving around frequency of breakdowns and the availability of manpower to address them. The performance of the department vehicle maintenance program, being subjected to these fluctuations, needs evaluated for effectiveness.

Purpose of the Study

The purpose of this study was to be able to recommend to the Madison Township Trustees which method would be most effective to achieve vehicle maintenance in a cost effective manner.

Research Questions

The research questions this study investigated by a descriptive research were:

1. What are MTFD current vehicle maintenance practices and costs?
2. Do skill levels of maintenance personnel vary for these services?
3. What are current vehicle maintenance practices and costs of other departments

comparable in size and run volumes?

4. How does MTFD compare to surrounding departments on vehicle maintenance practices and costs?

BACKGROUND AND SIGNIFICANCE

The Madison Township Fire Department is located in Franklin County, Ohio. It serves a population of approximately 21,000 people in a 40 square mile area, providing fire suppression, prevention, investigation and advanced life support emergency medical services. The department has two stations, 44 full time and 16 part time employees (Bates, 2010).

The Township Trustees have expressed an interest in consolidating services in order to become more efficient, and has also hosted departmental meetings to solicit ideas from its employees. One such idea was for all three departments to combine resources and to hire a shared mechanic to address all vehicle maintenance concerns.

Madison Township fire, police and road departments altogether manage 38 vehicles. Fire department vehicles include six frontline apparatus, two fire engines, two paramedic squads, a foam supply and one command vehicle. The auxiliary fleet consisting of an engine, two paramedic squads, two command vehicles and various staff vehicles.

In the past, the fire department has tried many different methods to control vehicle maintenance, mostly revolving around needed repairs. Morale about repairs is disappointing because the members don't receive any feedback from problems they report. When vehicles come back from the shop, no report is given on what repairs were made. This lack of feedback has made members leery of turning in repair orders. The department has assigned maintenance to a company firefighter then created a forty hour firefighter position dedicated to vehicle maintenance. Many of these issues were getting addressed but the fleet had many older vehicles needing a lot of attention. Departmental goals and objectives changed and the forty hour position was split between maintenance and fire prevention activities until a retirement shifted the responsibility to an assistant chief, working forty hours a week scheduling all maintenance.

Preventative maintenance benchmarks began to fall by the wayside and members started spending more time in reserve apparatus only to have it breakdown too forcing them to borrow vehicles from surrounding departments. Budget swings raise questions as to whether we were spending too much maintaining older equipment versus purchasing new (See Table 1).

Table 1

Comparison between Amount Budgeted for Maintenance and Amount Actually Spent

	Appropriation: 10-A-10A : Repairs – Fire Vehicle		
	Budgeted	Actual	Difference
	$	*$*	%
2004	45,000	59,532	+32
2005	65,000	59,195	-10
2006	60,000	77,034	+28
2007	50,000	40,870	-22
2008	45,000	50,266	+12
2009	45,000	50,198	+12
2010	55,000	22,759	-40[a]
TOTAL	355,000	387,293	32,293

[a] Year to date (as of 1 August 2010).

The police department has nine cruisers and four staff vehicles, for which maintenance is scheduled by a civilian employee who also maintains the building. The road department superintendent and his crew maintain their fleet of vehicles, including five pickups, four dump trucks, and one backhoe.

Adjacent departments have employed mechanics in three different environments; one uses a mechanic solely for the fire department, one has a single mechanic shared between the various governmental departments and the third has a shift officer maintaining all vehicles. This paper seeks to collect and evaluate relative data and information, in order to provide recommendations to the Madison Township Trustees for a more cost effective method of servicing fire department vehicles. *The potential impact this study could have on the Madison Township Fire Department is* to reduce costs associated with maintaining vehicle in-service status and extending the vehicle service life for the customers they serve.

LITERATURE REVIEW

Research material for this paper includes on-line services provided by the National Fire Academy (NFA) Learning Research Center (LRC), the National Fire Protection Association (NFPA) codes on-line membership provided by our department and Google internet searches. Also included are articles from trade magazines, periodicals, books and other online sources.

Answering research question #1 – What are MTFD current vehicle maintenance practices and costs. The body of this question is answered by interviewing Lt. Mark Ballenger and reviewing past maintenance expenditures. However, this author gained insight reviewing NFPA 1911 *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, Annex C Developing a Preventive Maintenance Program (2007)* and its emphasis on the importance of preventative maintenance (PM) on fire apparatus as it relates to firefighter safety and increased service life. This standard states that it is not enough just to repair problems when they occur or to perform maintenance when it is convenient to have it done. Maintenance programs will vary based on the size and resources available to each department but the goal to keep vehicles safe and ready when needed will be a common theme.

PM programs administered in a timely manner will save fleet manager money by extending vehicle life, reducing shop time and eliminating breakdowns. Each vehicle comes with a program specifically recommended for them by the original equipment manufacturer (OEM) usually timed to coincide with an oil change schedule. While following this schedule reduces vehicle costs, shortening PM intervals will not achieve any better results only increased costs. Unscheduled downtime is very expensive and can be avoided by evaluating breakdowns to determine what issues are causing the problem. (Gelinas, 2009)

NFPA 1915 (Standard for Fire Apparatus Preventative Maintenance) defines the minimum requirements for establishing a PM program for fire apparatus. Identifying the intent of a successful PM program is "to ensure that fire apparatus are serviced and maintained to keep them in safe operating condition and ready for response at all times."

Answering research question #2 – Do skill levels of maintenance personnel vary for these services? Many components of an emergency vehicle are not unique and can be serviced by any certified mechanic on a routine schedule (Tune-ups, oil changes, etc.). (NFPA 1071, 2006) recognizes fire apparatus as complex pieces of machinery having many components that are highly integrated (e.g., the engine, transmission, and pump with the electronic lockups and interlocks, remote engine controls, multiplexing, special cooling considerations). Because of such complexity, this standard creates three levels of emergency vehicle technicians and establishes the skills and knowledge needed to perform repairs on these systems.

Answering research question #3 – What are vehicle maintenance practices and costs of other departments comparable in size and run volumes? The survey questions and individual interviews formed the majority of the answer to this research question. This author found additional information in reviewing literature on this question. The Federal Energy Management Program reports that almost half of all companies in the United States utilize a "reactive" maintenance program, fixing problems as they present themselves instead of taking a more proactive approach to vehicle maintenance. Reactive vehicle maintenance will yield some short term savings but they will disappear over the life of the vehicles. The expenses associated with a preventative maintenance (PM) program, diagnostic tools, training and equipment are often questioned at start-up but these apprehensions are overcome with increased customer satisfaction and savings in downtime. A newer approach to PM is called "predictive" maintenance, which

uses “wear indicators” in addition to regular scheduled maintenance intervals to predict failures of equipment. Savings realized by use of this system can be an additional 8%-12% over standard PM alone. (Howe, 2007)

Another measure to determine if a PM program is cost effective would be to track the number of times the vehicle requires unexpected service between regularly scheduled PMs. A decrease in required service will demonstrate a more efficient PM program which directly affects downtime and cost. Since no two vehicles are the same it is important to divide the program based on type of vehicle, usage, and frequency of usage. A specific schedule for engines and medics would be justified as would a separate schedule for staff vehicles. Recordkeeping is also important to recognize repetitive maintenance or “trouble” components in order to forecast future repairs or target defective components for replacement (Public Works Staff, 2006)

Reasons for having a preventative maintenance program include the need for all emergency equipment to be kept available in ready to respond condition. The operators and the general public’s safety depend heavily on the vehicles ability to perform. The major cost associated with the purchase of fire vehicles demands that measures be taken to ensure the life expectancy of the vehicles as well as protect the investment the department and community have made. Improperly maintained fire apparatus can result in legal action and financial rewards to parties seeking damages for injuries suffered due to neglect. (Peters, 2004)

NFPA standards including apparatus inspection, maintenance, testing, qualifications and retirement are considered “industry standards” and while not laws, these standards still carry legal standing which would stand up in a court of law (Cavette, 2005)

Down time increases the chance that a frontline piece of equipment is not available to respond and taxpayers demand that their investments are properly cared for and available when

needed. The savings provided by PM is evident in the decrease in equipment failures and longer service life. "Long-term benefits of preventative maintenance include: …system reliability, decreased cost of replacement …downtime, and better inventory management" (ReliaSoft Corporation, 1999-2007 p. 1).

Economic downturns force fleet managers to cut capital funds for vehicle replacements, which forces departments to analyze which vehicles can go another year or two. Paying more on the front end by ordering more robust equipment will enable the vehicle to surpass normal replacement cycles if needed (Kilcarr, 2010). Extending PM intervals is also being used to control costs. It is important to choose the right vehicle for the application as equipment too light can result in more breakdowns, while equipment too heavy carries unnecessary costs.

Answering research question #4 – How does MTFD compare to surrounding departments on vehicle maintenance practices and costs? This author found little help with this research question in a literature review. The practice of conducting thorough reviews of maintenance expenses for each vehicle was valuable.

All apparatus should be subjected to annual performance testing. Maintenance records should be compared to the results of these tests to determine a cost trend in the maintaining of the apparatus. It is important to recognize when a point is reached where maintenance costs are increasing and the value of the apparatus has decreases to the point that it is no longer economical to continue investing in repairs. (Peterson, 1994)

In summary, vehicle manufacturers of all makes and models develop standards for the maintenance of their product for a defined "normal" service life. These standards have been recognized by industry to achieve and/or extend the life of the investment resulting in more profit for the company. These standards are recognized by the National Fire Protection

Association for also increasing firefighter safety. With this information this paper sought to research how to accomplish this in a cost efficient manner.

PROCEDURES

The first part of this research began with a literature search on-line using search engines and key words such as preventative maintenance/maintenance, fire trucks, ambulances and emergency vehicles. This lead to electronic periodicals, organizations web sites, reports and county, state and federal government web sites. The MTFD on-line account was used to review NFPA codes that addressed preventative maintenance and professional standards for fire equipment. The goal was to review and understand how vehicle maintenance impacts the operations of our organization in costs per vehicle, man hours lost to repairs and vehicle in-service hours lost compared to surrounding departments.

The primary method of research utilized in this applied research project was descriptive. The main focus was to develop new processes and procedures to solve an urgent problem within the MTFD at the conclusion of this research.

In addition to published material used for this report, several one-on-one interviews were conducted to gather additional information regarding vehicle maintenance practices used both in and around our jurisdiction. On Monday April 4, 2011, This researcher interviewed Madison Township Lieutenant Mark Ballenger who now shares this responsibility in order to get a baseline for comparison and address research question number one. Data from the police and road departments to get a total cost of Township dollars spent on vehicle maintenance.

In researching the first and second research questions, data was requested from the Madison Township Fiscal Office. They maintain all expenditures made by the four Township departments, road, police, fire and administrative. Computer printouts reviewed did not contain the information needed to distinguish between the many different types of maintenance performed, labor costs, lost service time, loss man hours etc. It became apparent

that this information would have to be obtained by first finding the expenditure on a long report, locating the date of repair, finding the box the receipt was filed in and then searching that box for the receipt. This process seemed daunting and worthy of a career versus a short term research paper. It is because of this lengthy process that a specific vehicle and period of time will be used for this paper.

In pursuit of the third research question this author, after discussions with OFE Director Dr. William Ashley, developed a survey to collect data from fire departments surrounding MTFD that have taken different approaches to vehicle maintenance. The three local approaches to vehicle maintenance explored were; a company officer, a full-time fire department mechanic and a full-time mechanic shared between different departments. This survey was emailed to the local fire departments along with a brief explanation of the research papers objective. Due to the small number of departments involved and the follow-up interview, a 100% return rate was achieved. The list of interview questions is located in Appendix A. These questions were used as a baseline for all interviews, but interviewees were encouraged to offer any advice they had picked up along the way.

Violet Township Fire Chief John Eisel and department mechanic Christopher "Doc" Metzger were interviewed on Tuesday March 22, 2001 at fire station 592. Violet Township's approach was to hire a part-time mechanic and he was responsible for maintenance on all Township fire and road department vehicles, over time developing into a full-time position.

Jackson Township Fire Captain Steve Cook and mechanic Mike DeWitt were interviewed on Friday April 1, 2011 at fire station 202. Jackson Township hired a mechanic and he is responsible for maintenance on all Jackson Township fire department vehicles. Originally

this author believed Jackson Townships mechanic was dedicated to the fire department, only to discover that he too is shared with the road department.

Mifflin Township Fire Captain Jamie Yinger was interviewed on Saturday March 26, 2011. Captain Yinger is a company officer assigned to station 132. In addition to his regular duties he also is responsible for overseeing vehicle and equipment maintenance for the department.

These interviews lasted an average of three hours and follow-up questions if needed were addressed either by email or phone. All participants were eager to discuss this issue and their department's successes and failures in addressing it.

Limitations of the Study

The departments surveyed were limited to just those surrounding Madison Township, this was done to localize the solutions. Additional departments could be included to obtain a more varied field of answers. Study was also limited to departments of similar size and demographics. Larger departments might be better at tracking critical information. Finally, this program focused mainly on the maintenance of fire vehicles although this author believes these practices could be used across the board.

RESULTS

In conducting this research project, a survey was used in conjunction with face to face interviews to determine how area fire departments with similar demographics were addressing fire apparatus maintenance.

The original research questions initially proposed were answered as a result of this descriptive research, the survey and subsequent interviews. Survey questions one through nine establish demographics for comparison (Appendix 2, figures 1-4).

Survey question #1 reveals a five million dollar gap between the lowest to highest annual budget. Mifflin Townships' maintenance budget eclipses the nearest competitor by over one hundred twenty-eight thousand dollars. They had paid a flat administrative fee to the City of Gahanna for all maintenance needs, preventative and repairs. The "flat fee" was for using their services and they received a discount on all services rendered. Dissatisfied with the results they kept the budget the same and appointed a company officer to manage the program. Preventative maintenance was $33,000.00 in 2009 with Gahanna and in 2010 they have used $8,000.00 in the same period. Advantages sited are warranties on all work performed, PM scheduled and performed in their stations. This is a huge time saving factor in that it saves change-over time and travel time. The saving of change-over time is a big morale booster with the employees and the equipment stays in-service in district while PM is being performed.

All of the departments in the survey are a combination of full-time and part-time employees with the exception of Mifflin who recently created a new full-time employee step that in effect turned their part-timers into full-time employees.

Questions 5 through 9 ask how many frontline, reserve and staff vehicles each department maintains. The author combined these answers into Figure 4 in Appendix 2.

Clearly shown in Figure 4 is that all departments have more staff vehicles than fire or EMS vehicles. Included in the staff vehicles are chiefs, assistant chiefs, battalion chiefs, fire prevention, station cars and maintenance vehicles. The majority of these run on gasoline versus the heavier diesel engines used in the engines and medics.

Research question #1 and #3 asks "What are current vehicle maintenance practices and costs of MTFD and other departments?" Survey questions 10 – 30 address these questions.

Of interest to this author was that answers to survey question #10 "How are vehicle problems supposed to be reported?" shows the larger departments rely on forms to report vehicle problems while smaller ones rely on the computer and even face to face. Of course face to face is used by all to further define the problem if the write up is not satisfactory.

All departments responding to question #11 "What vehicle information do you require when maintenance problems are reported?" indicated that the hour or mileage information will vary depending on the type of vehicle or engine being used. Most fire apparatus come with engine hour gauges while most gasoline engine maintenance is based off of mileage. Madison Township forfeits some information making the process simple for the employees by using a popular format (Google calendar). Violet Township uses the mechanic to note the mileage/hours when performing repairs.

Requests for maintenance are given to the mechanic and/or the program coordinators.

Responses to Question #13 "Is the person reporting the maintenance request supposed to get feedback on repairs made?" depended on the type of service needed. If a person reported the steering pulling to the left they would sent it out for an alignment. If there were no outstanding problems they would not report back they got it aligned. Madison Townships' posting a follow-

up report on the same Google calendar entry seemed the most consistent; unless there were multiple write-ups then others might not be addressed.

Coordinators oversee the maintenance programs, the exceptions being Violet Township that uses their mechanic and Jackson Township where the mechanic and captain work together on the program.

In general if they had a mechanic they did all the work their shops could handle both PM and repairs. If they did not they did the little stuff in house and contracted the rest out. Vendors were chosen by word of mouth and shopping around for the best price. Mifflin Township recently conducted an exhaustive search for vendors that could meet their needs as a primary or secondary provider.

Even if the departments had their own mechanic they did not have their own shop. Many had set up areas in a firehouse bay where they kept their tools or performed most of their maintenance. Violet Township built a three million dollar maintenance facility in a new road department building that is shared with the fire department when needed for larger repairs. They are pursuing purchases of equipment that will aid them in repairing trucks. As an example they have a hydraulic hose making machine that enabled them to replace their own hose and the truck was back in-service without even having to be shut off. Saving hours, perhaps days on a repair and lost service life from that equipment.

Only Violet Township has a shared stand alone maintenance shop but it is shared with the road department. They use it to maintain not only their dump trucks and pickups but also a wide variety of specialty equipment (mowers, tractors/backhoe)

Jackson does 90% of their maintenance in the bay inside the firehouse. Mifflin does 35% of their maintenance (mostly PM) by an outside vendor coming into their firehouse to do the

work. Violets' mechanic is able to take his tools to the station in his truck, which is also equipped with a stock of parts that might be needed for repairs. If the repairs cannot be made there they will take the vehicle to the road department shop and work on it there. What little maintenance Madison does on their equipment is done at the firehouse with the rest contracted out.

Madison and Mifflin, having no mechanics purchase all the tools for minor repairs made in the firehouses. Jackson has a mechanic yet still buys all the tools for his use. Finally, Violets' mechanic had his own tools from previous employment, he uses them as needed and if they get damaged or lost either his supplier or the department will replace. It should also be said that if a department has a special tool and another one needs it for a repair that a loaner network exists.

Research question #2 asked "Do skill levels of maintenance personnel vary for these services?" Survey question #20 asks "Do skill levels of maintenance personnel vary for these services?" Madison and Mifflin do not have mechanics on staff but do send their trucks out for repair. It is these repairmen that have the certifications needed to make the proper repairs. Both Violet and Jacksons' mechanics carry ASE and EVT certifications. It was noted that achieving these certifications is very time consuming with each specialty having 12 ASE and EVT tests to achieve certification. Chris Metzger from Violet still strives for his EVT III (master) certification. This author found it surprising that there are less than 100 in the State of Ohio with only 500 in the United States.

Madison and Mifflin with no maintenance staff have only the cost of administration and transportation which is manpower to get the trucks to the shop resulting in a few thousand dollars versus Violet and Jacksons' staff salaries with benefits added averaging around ninety thousand dollars. Both Violet and Jackson have a part-time assistant who helps out with maintenance.

Questions 22, 23 and 24 address procedures by asking what the departments do when a frontline engine, medic or staff vehicle are out-of-service (OOS). Each department operates a reserve apparatus that stands in the place of the frontline when it is necessary to take it down for maintenance. Specialty equipment such as a rescue or ladder would either be borrowed from another department if possible or just substituted with a reserve engine with less equipment or as manpower. In a worst case scenario the department would go without.

When normally done PM is scheduled by either engine hours, for a diesel engine, or engine miles in a gasoline engine. However if a truck was down for another repair they all said they would look at the timing to see if other work could be done. As an example Madison needed to remove old mobile data terminals (MDT's) and install new ones. Engine and medic 181 were due for service, the crews did the change-over and after the scheduled service they installed the MDT's. The savings in change-over down time improves morale.

Not surprisingly if they have a mechanic on staff he does all the work he can himself. Similar to Question 15 when asked if regular maintenance that is contracted out. Preventative maintenance can be planned for once the vehicle is purchased. Knowing the tools and parts needed to accomplish the job before they are needed helps the mechanics prepare.

The respondents were hesitant on answering Question 27 "What is the average down time for preventative maintenance?" because the department mechanics were inclined to look around for issues not reported. Pulling the dash to replace bulbs that had burnt out but not been noticed. It is this searching for wear indicators that is so vital to the predictive maintenance programs success. The average was 2.5 days.

All departments regardless of whether or not they had a mechanic responded that 25% of their maintenance time is spent addressing PM.

This author was surprised that given the amount of money spent in effort to maintain vehicles readiness that all departments don't have some type of policy addressing vehicle maintenance. Only half of the departments surveyed, regardless of whether they had a mechanic have a standard operating procedure to address vehicle maintenance. The author was quite impressed with the work done by Mifflin Township and their maintenance committee.

All responding departments can track maintenance expenses by the vehicle and per year. This would not however be a comprehensive evaluation that could be broken down for details. Many of the departments spoke of the lack of specific maintenance programs within their organizations that would enable them to be able to breakdown all repairs and notice trends or do queries. This was one item that was consistent across the board. Breaking down operating costs per mile or per hour is one way being touted by the industry to aid in determining if a vehicle should be repaired or replaced.

The majority of departments are satisfied with their programs, Jackson being "Very Satisfied" and Madison being 75% satisfied and 25% unsatisfied. Madison being proud of their recent accomplishments addressing reporting issues and the recent finding of a local repair shop that practices "predictive maintenance".

DISCUSSION

The need to evaluate the performance of the vehicle maintenance program guided this research to identify alternative methods of reducing associated costs. Valuable insight was gained that will assist our department determine actions necessary to obtain this goal.

The literature review identified these methods in which vehicle maintenance can be addressed: 1) Predictive maintenance, using “wear indicators” in addition to regularly scheduled intervals to predict failures of equipment; 2) Preventative maintenance based on original equipment manufacturer (OEM) recommendations on maintaining optimal vehicle operating conditions; and 3) reactionary maintenance, which is fixing problems as they present themselves.

(Howe, 2007) identifies predictive maintenance as the most economical ways to approach vehicle maintenance with savings reportedly 8% - 12% over preventative maintenance alone. This author found this method being practiced, in various forms, at the three local departments interviewed. All three of these departments reported addressing vehicle maintenance issues in advance of normal PM guidelines and answered favorably when asked about their PM programs effectiveness. In the MTFD, vehicle maintenance was preventative as a goal but more resembled reactionary. The Federal Energy Management Program reports that almost half the companies in the United States utilize reactionary maintenance for their vehicle maintenance needs.

The literature review did support preventative maintenance programs as successful in achieving cost savings during the life of all vehicles. Survey results indicated area departments realize this and have taken progressive ways to ensure its delivery. This can be seen in their use of predictive vehicle maintenance, whether it is administered by their own mechanic or mechanics of similar beliefs working for private vendors.

Brown (1992) recommends that all data collected on fire apparatus should be arranged to accommodate statistical analysis. Capitol Safety Systems (1991) stress that variables such as maintenance costs and “downtime” were recommended for consideration when determining the replacement of vehicles. This author could not find this “downtime” data being collected by any fire agency surveyed. ReliaSoft Corporation (1999-2007) says savings provided by PM is evident in the decrease in equipment failures and longer service life. While all agencies interviewed reported both of these findings, none were able to substantiate the results. In comparing vehicle costs between departments large discrepancies can be seen. (See figures 5 & 6)

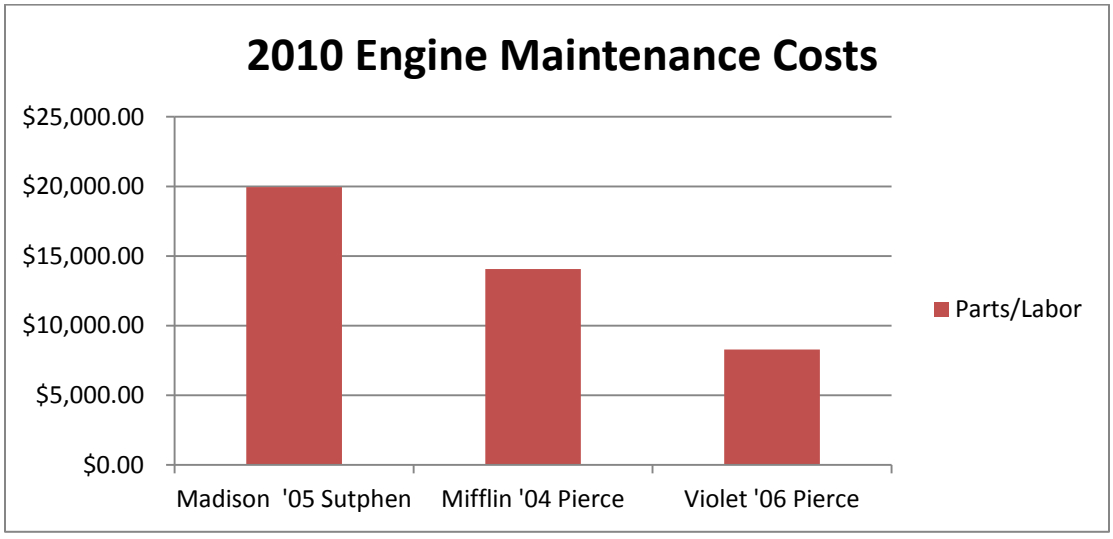

Figure 5

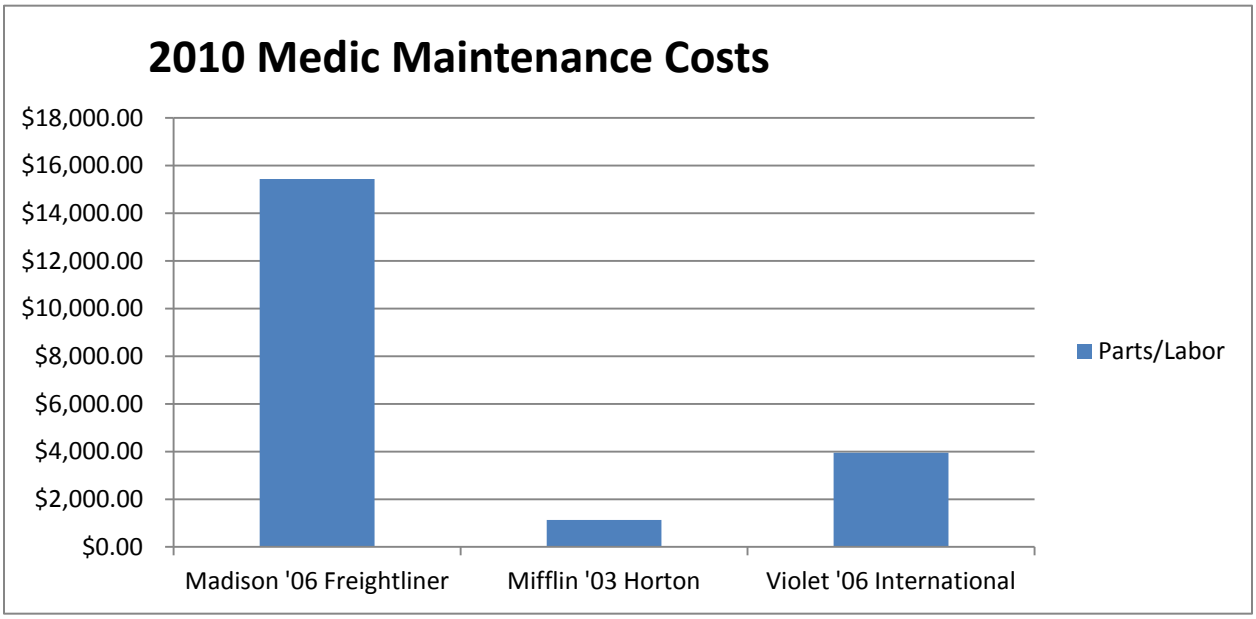

Figure 6

The impact of this research for the Madison Township Fire Department is that justification for the use of effective vehicle maintenance practices exist. They are not available in the form of a study or survey but must be prepared by the organization itself. This author has found that the literature review and interviews of area departments while lacking in strong supportive data suggest that predictive maintenance will save on downtime and extend the service life of MTFD apparatus. By implementing procedures that will capture and track data such as; vehicle downtime, service life, scheduled/unscheduled maintenance and breakdowns, trends can be indentified and acted upon. Researching changes in industry standards and collecting all available data from department maintenance records, the department can prepare documentation justifying changes that can be made to ensure the efficiency of the MTFD vehicle maintenance.

RECOMMENDATIONS

The problem this study addressed was the lack of information available to suggest how cost savings might best be accomplished in vehicle maintenance. While data on past operational costs are available, a thorough analysis of operational practices, costs and potential future options this data does not exist in a form that can be used to support a plan for cost reduction.

1. A review of our own Township records provided limited information that needs to be strengthened with additional details. The collection of significant data needs to begin so that operations can be modified and produce the desired savings. Separating labor and parts costs will assist the department justify whether it can benefit from hiring a mechanic. Tracking vehicle out of service time and breakdowns will be useful in identifying trends that need action. Ultimately figuring maintenance costs for each vehicle per mile and/or **e**ngine hour will provide a level field for analyzing annually to decide when to continue repairs or consider replacement.

2. Operating procedures should be created detailing every member's responsibility towards the reporting, repairing and maintaining of fire apparatus to eliminate the "ready, fire and aim" mentality. Included in this procedure should be the definition of a maintenance coordinator and its decision making authority. A survey of all users should be conducted to obtain the expectations of a successful vehicle maintenance program, discovering and addressing any deficiencies in the current system.

3. Vendors should be interviewed and department expectations revealed. Such expectations might be instant access to repair personnel, on-site repairs, recordkeeping and discount pricing. Successful vendors should receive our business and the Township should realize decreased downtime and increased vehicle service life. Township Trustees should be kept up to date on the condition of the vehicle fleet and expenses incurred maintaining it. When

it comes time to make a major decision to repair/refurbish or replace a vehicle it will not be the first time they are hearing about it. These decisions have major impacts on annual budgets; they should not be a surprise.

This author started on this journey initially believing that money could be saved by the hiring of a mechanic to be shared between the three Township departments. However upon completion of this paper the author discovered the savings depended less on money and more on the efficiency of the operation. Reducing downtime that comes with changing into another vehicle, transporting vehicles to service facilities and waiting for the parts or for a mechanic are the three main areas affected. The vehicles increased service life enabled departments to save the money needed to replace them. In speaking to department mechanics one can't help but feel that they are a vital need in any fleet over 15 vehicles but this author was disappointed in the lack of data available to verify this recommendation.

The absence of data to justify changes indicates that further research in this area is needed. Future authors might benefit by expanding upon this research by conducting a survey to determine how much downtime is normal in the service life of fire and medic vehicles. This survey should take into consideration the different variables such as year, make and model of chassis. Other variables could be mileage, hours of service, run volume and routine maintenance received should be taken into account.

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APPENDIX 1 – INTERVIEW QUESTIONS

1. What is your annual fire department budget?

   a) 5 – 7 million dollars
   b) 7 – 9 million
   c) 9 – 11 million
   d) 11 – 13 million
   e) 13 – 15 million
   f) 15 – 18 million
   e) 18 – 21 million
   f) over 21 million

2. What is your annual vehicle maintenance budget?

   a) 0 – 10k
   b) 11 – 30k
   c) 31 – 50k
   d) 51 – 100k

3. What type of department do you have?

   a) Full-time
   b) Part-time
   c) Volunteer
   d) Combination

4. What is the number of incidents your department responds to on an annual basis?

	FIRE	EMS
a) Less than 500	____	____
b) 501 – 1k	____	____
c) 1,001 – 2.5k	____	____
d) 2,501 – 5k	____	____
e) 5,001 – 10k	____	____
f) 10,001 – 20k	____	____

5. How many front line fire engines do you maintain?

   a) One
   b) Two
   c) Three
   d) Four
   e) Five
   f) Six
   g) Seven
   h) Eight

6. How many reserve fire engines do you maintain?

   a) One b) Two c) Three

7. How many front line medics do you maintain?

   a) One
   b) Two
   c) Three
   d) Four

8. How many reserve medics do you maintain?

   a) One
   b) Two
   c) Three
   d) Four

9. How many staff vehicles do you maintain?

   a) One
   b) Two
   c) Three
   d) Four
   e) Five
   f) Six
   g) Seven
   h) Eight

10. How are vehicle problems supposed to be reported?

    a) Form submitted through channels
    b) E-mail to face with mechanic or person scheduling.
    c) Face to face with mechanic or person scheduling.
    d.) Other, explain:

11. What vehicle information do you require when maintenance problems are reported?

    a) Odometer
    b) Hour meter
    c) Problem
    d) Person reporting
    e) Vehicle
    f) Date

12. Who gets the vehicle maintenance requests?

    a) Mechanic
    b) Chief
    c) Assistant chief
    d) Maintenance person
    e) All the above

13. Is the person reporting the maintenance request supposed to get feedback on repairs made?

    a) Yes
    b) No
    c) Sometimes (why or why not?)

14. Who is responsible for the maintenance of your fire apparatus?

    a) FD Maintenance
    b) FD Coordinator – Separate vendors
    c) City/Twp. Maintenance
    d) Separate vendors

15. What maintenance is done and what maintenance is farmed out.

	Done	Contracted	Both
Fire	____	____	____
EMS	____	____	____
Staff	____	____	____

16. Does your department have their own Fire Maintenance Shop?

a) Yes b) No

17. Is your maintenance shop dedicated to Fire/EMS apparatus only?

a) Yes b) No

18. Is your apparatus maintenance shop a separate building or the in the firehouse?

a) Separate building b) In the Firehouse

19. Who is responsible for the mechanics tools?

a) The mechanic owns them.
b) Department supplements the mechanic.
c) Adding to collection over time.

20. What level of education does your mechanic have?

a) Life Experience
b) ASE certified
c) Emergency Vehicle Tech I
d) Emergency Vehicle Tech II

21. What annual personnel costs do you spend on maintenance?

a) 0 – 10k
b) 11 – 30k
c) 31 – 50k
d) 51 – 100k

22. When a front line engine is out of service for maintenance what do you do?

a) Use reserve
b) Borrow a neighboring vehicle
c) Go without

23. When a front line medic is out of service for maintenance what do you do?

a) Use reserve
b) Borrow a neighboring vehicle
c) Obtain a short term rental
d) Go without

24. When a staff vehicle is out of service for maintenance what do you do?

a) Use reserve
b) Borrow a neighboring vehicle
c) Go without

25. How is your preventative maintenance scheduled?

a) Mileage
b) Hours
c) When truck goes down for other maintenance

26. What preventative maintenance is done and what maintenance is contracted out.

	Done	Contracted	Both
Fire	____	____	____
EMS	____	____	____
Staff	____	____	____

27. What is the average down time for preventative maintenance?

a) Days _____?
b) Weeks_____?
c) Months_____?

28. What percentage of maintenance time is directed toward preventative maintenance?

a) 5%
b) 10%
c) 15%
d) 20%
e) 25%
f) 50%
g) 75%
h) 100%

29. Do you have an SOP for vehicle maintenance?

a) Yes b) No

30. How do you track your maintenance expenses?

a) total per vehicle
b) per maintenance man hour
c) per hour of vehicle operation
d) total per year
e) per mile
f) other _____?

31. What is your level of satisfaction with your maintenance program?

a) Unsatisfied _____. Why? _____
b) Satisfied _____. Why? _____
c) Very Satisfied _____. Why? _____

APPENDIX 2 – SURVEY FIGURES

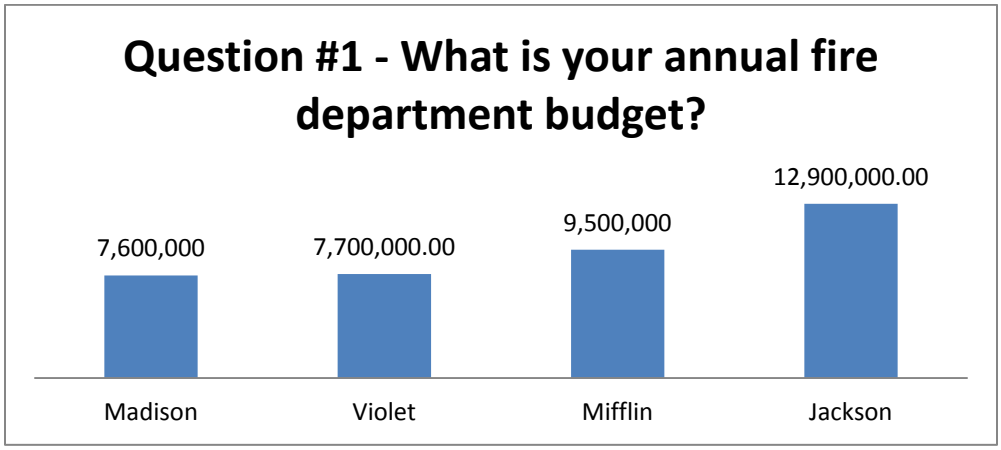

Figure 1

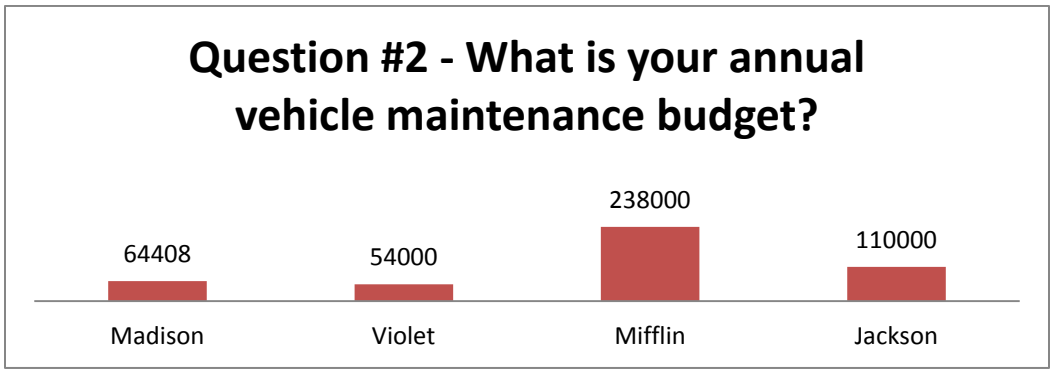

Figure 2

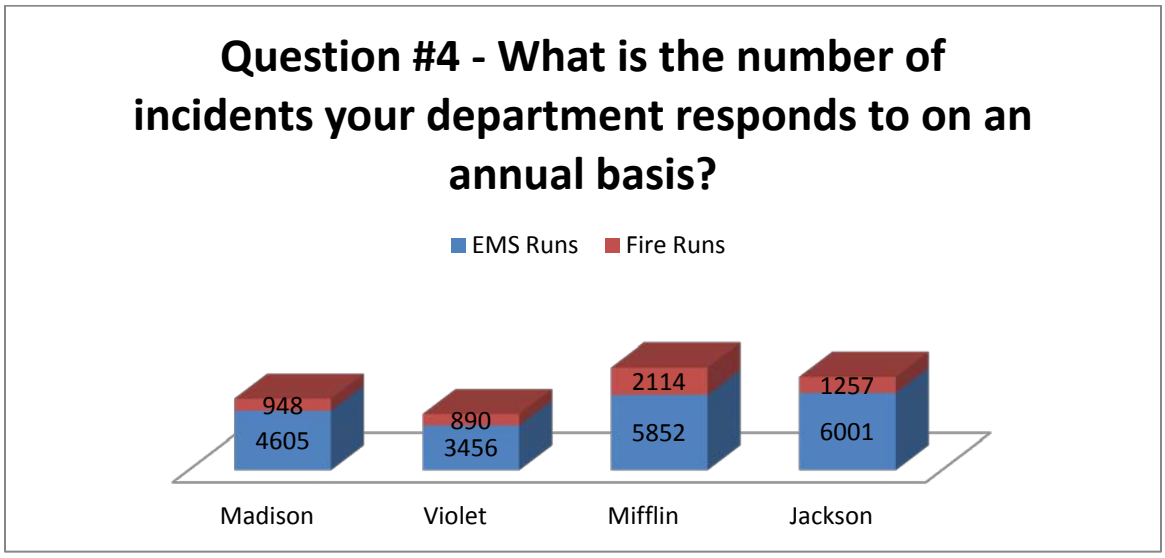

Figure 3

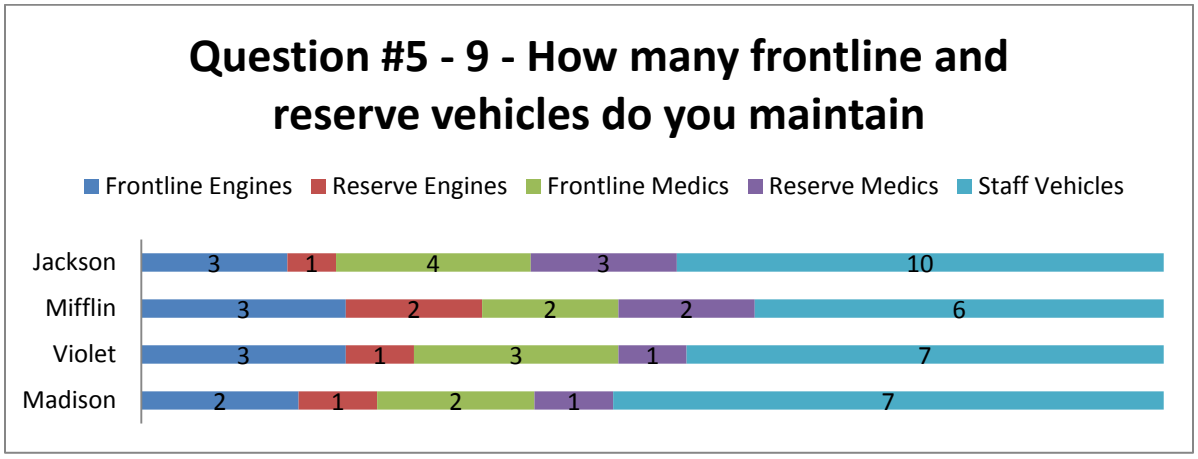

Figure 4