Examining Fleet Maintenance at the Delhi Township Fire Department

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CERTIFICATION STATEMENT

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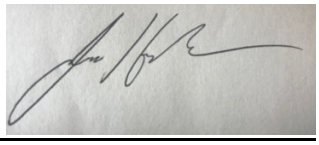
Signed: 

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Abstract

The problem is that the Delhi Township Fire Department (DTFD) has experienced frequent delays in vehicle repairs and had financial concerns with sending vehicles to outside vendors. The purpose of this study was to identify the current methods the DTFD used to repair and maintain the fleet of vehicles and determine if those methods were economical and efficient, and if not then examine what other methods are available. The project used an evaluative research methodology to answer: How much money does the DTFD spending on fleet repairs, and where is it spent? How do similarly sized departments repair and maintain their fleets, and what is their budget? What are the logistical problems affecting fleet maintenance, and what can be done about them? Are firefighters confidant that repairs will be done quickly and correctly? Several methods of data collection were used. A review of the department's budget was conducted. Surveys were developed to gauge the confidence the firefighters had in the maintenance program, and to see if they had any ideas for improvement. An external survey was developed to see what other departments in the area were doing for vehicle maintenance. The Fire Chief and mechanics were interviewed. DTFD spent $123,58 in 2018, this was more than comparable local departments. Only $9000 of this money is spent on outside vendors. Firefighters believe that repairs are done complete and timely. The mechanics need more time and help. A records management system is needed. The research yielded the following recommendations: Conduct a refresher training on how to perform checks on the trucks. Find an improved records management system. Scheduling and prioritization of all township vehicle repairs should be done as a group effort. The vehicle replacement schedule needs to be re-examined. Allow the fire department to hire the heavy truck mechanic full time.

Introduction

The problem this research project addresses is that due to the increased demand for vehicle maintenance of township vehicles, the Delhi Township Fire Department is experiencing frequent delays on repairs, and financial concerns with sending vehicles to outside vendors. Fire departments must have reliable, safe vehicles to deliver their services. Nearly every call for service requires a response in a vehicle. If a fire truck or an ambulance cannot respond because it is broken, or a spare is unavailable, then lives or property could be lost. Delhi Township Fire Department only has a limited number of spare vehicles to use when there is a breakdown or scheduled maintenance service. Delhi Township has two mechanics, who are shared among all the township departments. The fire department does not have a large enough budget to send out many repairs to outside repair vendors.

The purpose of this study is to identify the current methods the Delhi Township Fire Department uses to repair and maintain their fleet of vehicles, and determine if those methods are economical and time efficient, and if not then examine what other methods are available.

Information for this research was gathered from interviews, personal observation, an internal survey of fire firefighters, a survey of local fire departments, data analysis, and a literature review. The project used an evaluative research methodology to answer the following questions.

1. How much money does the Delhi Township Fire Department spending on fleet repairs, and where is the money being spent?

2. How do similarly sized fire departments repair and maintain their fleets, and what is their budget for these repairs?

3. What are the logistical problems that are affecting fleet maintenance, and what can be done about them?

4. Are firefighters confidant that repairs will be done quickly and correctly?

Background and Significance

Delhi Township is located in the southwest corner of Ohio. Delhi is the first suburb to the west of Cincinnati. There are over 30,000 residents living in 10 square miles, of the township. Up until after World War II, Delhi was known as a rural farming community. Truck farms, dairies, and greenhouses were the most common businesses. The nickname to this day for the township is, “The Floral Paradise of Ohio”. At one time Delhi Township grew the majority of the carnation flowers and poinsettias plants for the entire country. The carnation and poinsettia are used as symbols in the township flag, and logo. In 2018 the township is mostly single-family residential homes, some multi-family units, several senior living communities, and few commercial areas. ("Delhi Township Website," 2018)The world headquarters of the Sisters of Charity of Cincinnati is located on a 50 acre, 20 building campus, in Delhi. The Sisters of Charity of Cincinnati is a Catholic Order of nuns that established itself in Delhi in 1884. Along with the offices for the organization, the campus also includes all levels of nursing home facilities for its members: full nursing care assisted living care and fully independent living apartments. ("Sisters Of Charity of Cincinnati," 2018) In 1920 the Sister of Charity founded the College of Mount Saint Joseph, as an all female college. This small Catholic school is today a coed University with 4000 undergraduate and graduate students. This University provides a full-service college experience with on-site housing and recreation. ("Mount St. Joseph University," 2018)

In 1935 the Delhi Township Fire Department (DTFD) was founded after a large fire in the Motherhouse building at the Sisters of Charity of Cincinnati. The size of the department has grown with the growth in the population. Once the department was all volunteer, today the department has 33 career firefighters and 20 part-time firefighters. DTFD staffs 3 firehouses with 10-14 firefighters daily. In 2017 the department responded to 3363 calls to service for fire and EMS. The department has a fleet of fire trucks including 3 engines, 1 quint, 4 Advanced Life Support Medics, technical rescue trailer, and 7 staff vehicles.

Throughout the years the department has used many different methods to repair and maintain its vehicles. At the start and throughout the majority of the history of the department, repairs and maintenance were done in-house, by members of the department. From 1935-1986 the department was a private fire company that contracted to the township. The department was only paid a flat fee for the services it provided the township. The department was not able to use the services of the township, such as the maintenance garage and their mechanic. As a rural farming community, many of the members had a strong background in vehicle and tractor mechanics. The design of the vehicles was also much simpler and easier to maintain and repair. Most of the fire trucks that the department bought were based on commercial truck chassis. These chassis were picked because to the familiarity the firefighters had with them, and the ease of acquiring parts and performing repairs. Nearly any repair could be done in the station or at a local garage, and not a specialty shop. The departments first ambulances were based on Packard, Cadillac, and Ford station wagons. These ambulances were all very easy to repair and maintain in-house. The department would even re-chassis several pumpers and tankers in-house using the labor and skill of the members. As time progressed several factors have made it increasingly difficult to have fire department members maintain and repair fire vehicles. The department

changed from a mostly volunteer department, with members having other skills such as auto mechanics, to one with people who have little or no knowledge of vehicle repair. The biggest challenge to in-house repairs has come with the change in vehicle technology. The size of the fire trucks has grown in size, weight, and complexity. In the late 1970s and early 1980s, the department started to purchase custom-made fire trucks and ambulances. Shade tree mechanics could no longer work on these trucks and those with more experience were beginning to have difficulty. Repairs on these larger trucks had to be taken to shops outside the township, that specialized in heavy truck repair. Many parts for the bigger trucks had to be ordered and not kept in stock at the local auto parts store. Now even in-house repairs that the department was capable of handling took longer, because of the delay in getting parts. The increased complexity in fire vehicle design has virtually eliminated any of the department's members completing repairs on the fire vehicles. All of the major systems on the trucks, take specialty tools and training to master. Along with the complexity of the repairs, the length of time to complete the repairs has also increased. Emergency responses have been steadily increasing over the years. On-duty firefighters have been expected to take on additional roles and responsibilities. Firefighters are now expected to conduct fire inspections, help with fire education in the schools, teach first aid and CPR classes, and be involved with community risk reduction. All of these additional tasks have added up to less time being available to repair and maintain fire vehicles.

In 1986 the private fire company sold the department to Delhi Township for $1. This merger eventually led to the system that is in use today. Up until 2006, the fire department was sending most of its repairs to outside vendors. Before 2006 the fire department rarely used the Township Maintenance Department mechanic for repairs. The mechanic did not have the training, skills, and experience to effectively repair fire vehicles. The Delhi Township Police

Department had a full-time mechanic, who worked out of a garage behind the police station. This mechanic mostly did preventive maintenance type repairs on the police cars. Oil changes, filter changes, tire repair and rotation, and minor electrical repairs were the majority of the time spent working on cars. This mechanic also had a lot of axillary duties that he did in between car repairs. He did custodial work, impounded cars, set up speed signs, maintained the auction list, and ran a lot of errands for supplies. Around 2006 the police mechanic retired, and the Maintenance Department Mechanic left for another job. This departure of these two mechanics led to a restructuring in how vehicles are repaired in the township. The police mechanic position was eliminated and this position was transferred to the Maintenance Department. The new mechanic that was hired had many years working in large repair shops and dealerships, he was trained in the use of modern diagnostic computers and was up to date on current car repairs. This mechanic has the ability to service all of the light and medium duty vehicles in the township fleet. For the fire department, this meant that we now had someone we could send our staff cars, ambulances, and trailer to have him repair or perform preventive maintenance on. The mechanic they hired to replace the Maintenance Department's vacancy was a heavy equipment mechanic. This mechanic had his training in the Air Force as a heavy equipment repair specialist. He also had experience working at a fire truck vendor, repairing emergency vehicles, and another local municipality repairing fire trucks. This heavy equipment mechanic is very well rounded in emergency equipment maintenance, he can repair pumps, aerial ladders, complex electrical systems, and is versed in the requirements and standards of fire equipment. Both mechanics complement each other's skill set very well, between the two they have a broad knowledge base across vehicle maintenance, equipment maintenance, and repair.

In the State of Ohio when a tax levy is passed, the money that is brought in from that levy can only be used for what they levy stated it was for on the ballot language. If a fire levy was passed to provide fire service and emergency medical service, it could not be used to hire a grass cutter for the township. But, fire levy monies could be used to pay part of the salary of a township employee who cuts the grass at a firehouse. Only the time the grass cutter is mowing the lawn at the firehouse, are they allowed to be paid by fire levy funds. The Township has several levies in place. There is a fire levy, police levy, road levy, and a parks levy. Each one of these levies must be spent on its respective area. One of the ways the township is able to use levy money to pay for other township employees' salaries is the use of shared services. Shared services can be work performed by township employees, products bought communally, and portions of contracts to outside vendors for goods and services. Common shared service paid by the fire department include information technology including hardware and software, human resources, facilities maintenance, and vehicle maintenance. Both of the mechanic's services are budgeted through shared services. The amount paid by each township department is based on the percent of time spent repairing vehicles for that department, from the previous year. The payment amount includes the salary of the employee, health insurance, medical, and pension. In 2018 the fire departments shared service amount, paid over $77,000 for the heavy truck mechanic and over $13,000 for the light duty mechanic. Parts and supplies are paid by each department and are not included in the shared services amount.(*Delhi Fire Budget 2018*, 2017)

The workload for both mechanics has steadily increased over the years. As the fleet has grown throughout the township, there has been no additional mechanics added. As the entire township fleet ages the time and complexity of the repairs and maintenance increases. It is becoming difficult for all of the tasks that need to be accomplished on the vehicles to be

completed in a timely manner. With the entire township using one garage facility, prioritization among the departments can be challenging. The question becomes, " who's vehicle is more important". Many times the police and fire departments win this argument because they have to have their vehicles to maintain public safety. The fire department only has one spare fire truck and one spare ambulance to use when one breaks down. These spare trucks are the oldest in the fleet and do not have the most modern features and safety equipment. But, the Public Works Department can also argue that their trucks are needed to keep the roads repaired and clear from ice and snow from the street.

A simple solution to the work overload problem would be to send out any of the extra work to outside vendors. This has been done in the past in limited circumstances. There have been issues with using outside vendors. Quality of work, timeliness of repairs, and the overall impact to the budget and expense. Before the two current mechanics were hired, the fire department was using a local school bus company to perform preventive maintenance. An ambulance went to this shop for an oil change. During the oil change, the drain plug was not reinstalled after the oil was drained. When the department picked up the truck from service, it was driven a few miles before the motor seized up from lack of lubrication. This is one example of shoddy work that has been done on fire trucks from outside vendors, there have been numerous other times similar issues have occurred. Timeliness can also be an issue with getting repairs done by outside vendors. Outside vendors do not see the urgency in getting fire trucks repaired, like the department wishes they would. Large dealers, engine repair, and transmission shops have contracts with large trucking companies that give them priority service over municipal customers. The township and the fire department do not have an endless amount of money to pour into sending trucks to outside vendors. Repair shops tend to be higher in the price

they charge for repairs. The shops do not discount the price of the parts like the township mechanics do.

To function as a fire department and a township government, a better system or different methods need to found to fix, maintain, and repair the township fleet. This applied research project fits within several goals of the Strategic Framework of the United States Fire Administration. Goal 1: Reduce fire and life safety risk through preparedness, prevention, and mitigation. (*Strategic Plan Fiscal Years 2014-2018*, 2014, p. 10) The department cannot respond if it has not prepared by having fire and medical trucks that can safely deliver those services to its residents. Goal 2: Promote response, local planning and preparedness for all hazards. (*Strategic Plan Fiscal Years 2014-2018*, 2014, p. 11) As fire executive student, planning for the future is important. Budgetary decisions made now will affect the departments' ability to respond in the future. Goal 3: Enhance the fire and emergency service's capability for response to and recovery from all hazards. (*Strategic Plan Fiscal Years 2014-2018*, 2014, p. 12) Part of Goal 3 is the use of data to make decisions. By using facts to make solid decisions about the future of the department and the community, the scarce money that the department has will be maximized to its fullest potential. One of the roles of an Executive Fire Officer(EFO) is to look ahead and be pro-active, and nor reactive. The EFO is the one who should be leading the way with the development or implementation of the departments' strategic plan.

Literature Review

A literature review was conducted to help answer some of the questions raised by this research paper. Specifically, it was to find out what how the fire service is handling their

maintenance and repair of their fleets. What are the best practices in fleet maintenance? Sources for the literature review includes magazines, trade publications, and the National Fire Protection Association standards.

From time to time fire service magazines will publish small articles on apparatus maintenance. Magazines like Fire House magazine and Fire Engineering magazine do have articles on apparatus maintenance but they are geared more to the driver/operator, and not the fleet mechanic or administrator. The only current vehicle-related periodical that is fire service oriented is Fire Apparatus & Emergency Equipment magazine. This magazine is published monthly in a print and online version. Most of the content is related to new products for trucks, equipment for trucks, and building a new apparatus. There are reviews of equipment and emerging technology. This magazine does have one author who specifically writes about fleet maintenance and administration, Christian P. Koop. In an article that Koop wrote titled *Preventative Maintenance*, he details why he believes that preventive maintenance is so important. Koop feels that short-term cost savings by, eliminating or delaying required service will hurt in the long run. The potentials for delayed maintenance are unexpected breakdowns, out of service vehicles, increased repair costs verse's the maintenance cost, and increasing the organization's liability from accidents or breakdowns. This type of delayed action is called reactive maintenance. An interesting observation by Koop is one he makes about the role of the vehicle operator in the maintenance of the trucks," A rule of thumb is that technicians can find 60 percent of the problems during the PM inspection; drivers can potentially find 30 percent; and the remaining 10 percent can be addressed by replacing components prior to failure". (Koop, 2014, para. 12)

Small Fleet's Biggest Challenges is the name of an article found in Government Fleet Magazine. its describes the challenges that smaller fleet operations have. Some of the issues they mention, are scheduling, limited help, and having a diverse fleet to maintain. (Lubinsky, 2018)

The National Fire Protection Association (NFPA)has several publications that are applicable to this research. *NFPA 1911 Standard for the Inspection, Maintenance, Testing and Retirement of In-Service Emergency Vehicles* has information on all of the specific maintenance and evaluation that need to be done to fire trucks. This standard includes several printable check sheets that can be used to accomplish the recommended evaluations. This standard talks about proper documentation several times throughout the text. Annex C covers developing preventive maintenance (PM) program. It does not talk about how to physically manage a program, but rather what documentation is needed and that PM should be done on a schedule. Annex D of this standard is a guideline for first-line fire trucks and reserve apparatus. The text talks about in the last 10-15 years that technology and advancements in safety have grown tremendously. NFPA recommends conducting a risk-benefit analysis if your truck is over 15 years old. They are skeptical about refurbishing older trucks because they probably will not have all of the modern safety features a newly built truck will have. NFPA also recommends, ”Apparatus older than 15 years old that have been properly maintained and that are still in serviceable condition be placed in reserve status...”. (*NFPA 1911*, 2017, Chapter D1) In the same chapter, they recommend that any apparatus over 25 years old be replaced.

The fire service is not unique that its operations rely on vehicles to accomplish its mission. Over the road trucking companies, delivery services, and service and repair industries all have large fleets. Their maintenance challenges are similar to the fire service that when their trucks break down, they lose money, the fire service could lose lives. The trucking industry was

examined to see if they had anything specific to fleet maintenance. Two magazines were found, *Fleet Owner* and *Fleet Maintenance Magazine.* Both of these magazines had a very similar format to *Fire Apparatus Magazine.* They were a mix of industry news, advertisements, new product profiles, and articles.

Fleet Owner magazine had several articles on preventive maintenance. They had an article similar to Koop's, about making repairs early and not putting them off. *Preventive Maintenance can Keep Those Rising Costs Down* by Josh Fisher talks about some new ideas and technology in keeping up with preventive maintenance. They made the same assertions as Koop that delays in preventive maintenance will catch up to you and in the end, you will pay a high price in repairs, lost income. One of the concepts the article brought up was that the drivers' pre-trip inspection reports should get sent to the mechanic electronically. These reports along with the trucks Electronic Control Modules (ECM) can be combined together to help create predictive maintenance. With the predictive maintenance, you will be able to fix a problem before it breaks. With predictive maintenance, you are able to," Extend component life, reduce failures and breakdowns, scheduled maintenance on your time, minimize downtime, compliance with the manufacturer and regulatory requirements, and regulate your expense. (Fisher, 2018, para.11)

Another article from Fleet Owner Magazine was *Vehicle lifecycles vs. maintenance costs.* The article contends that newer vehicles have significantly reduced maintenance cost. If a new vehicle does have a major maintenance issue, many times it is covered under a manufactures warranty and will cost little to nothing to fix. Another benefit to newer trucks was newer technology and safety features. Again this article focused on preventive maintenance was key to extending the life of the vehicle. (Commendatore, 2016)

An interesting article was found in Fleet Maintenance Magazine. The title was *Outsourcing Maintenance.* The article talked about the City of Fort Lauderdale Fl, and that they outsource all of their fleet maintenance, and re-bid the contract for this service every 6 years. The city has been using this outsourcing model since 1981. This city has over 1500 vehicles of all sizes, including the fire department. (Kolman, 2011) This was the largest municipality that was found during this research that outsourced all of their fleet maintenance.

The literature review helped confirm some widely held beliefs. The articles found on vehicle maintenance all agreed that preventive maintenance was critical to the health and longevity of your fleet. Most had the central idea that you are either going to pay a little upfront or you are going to pay a lot when you have a catastrophic breakdown. The timing of repairs and maintenance was also a big topic in the articles. You can plan your maintenance out and schedule it, or the truck will break down when it wants. When the unexpected breakdown comes, it's normally not at a good time because of the budget, space for repairs, other trucks being repaired, or mechanics unavailable because of off-time.

Procedures

To answer the research questions that were posted, several methods of data collection were used. A review of the department's budget was conducted. Historical analysis of four years of the department's budgets and the amount spent on vehicle maintenance was gathered. Surveys were developed to gauge the confidence the firefighters had in the maintenance program, and to see if they had any ideas for improvement. An external survey was developed to see what other departments in the area were doing for vehicle maintenance. Interviews with the Fire Chief and the two mechanics were conducted.

Historical data was gathered by going through the budgets of the fire department from 2015-2018. In 2015 the way expenses were tracked changed to a tabulation for each individual vehicle in the fire department. The specific information that was being searched for in these reports was the amount of money paid for repairs and the amount of money paid to outside vendors. The data was found in four different line items. Vehicles-Fire Fleet account, included the staff cars, engines, quint, parts/stock, and miscellaneous/shipping expenses. EMS Repairs, Maintenance, included the ambulances, parts and miscellaneous/shipping expenses. Contracted Services, included the annual pump testing, and annual aerial testing performed by outside vendors. The Shared Services line had the amount paid to the two mechanics for their services.

Two surveys were developed to gather data. Survey Monkey was the vehicle used to send out the surveys. The internal Delhi FD maintenance survey was sent out using the department's internal email system to all fire department personnel. The second survey was sent out to subscribers of the Southwest Ohio Fire Chiefs email list.

An internal survey was developed to gauge the feeling about vehicle maintenance from the firefighter viewpoint. Appendix A lists the questions and the results. The first part of the survey was to see if the firefighter was trained on how to check their vehicle properly, and were they able to perform small repairs if they found them. The second part of this survey focuses on how they felt about the quality of the work performed and the timeliness of it. The last part of the survey gave them an opportunity to give their input on what they thought could improve vehicle maintenance.

The second survey was sent out to subscribers of the Southwest Ohio Fire Chiefs email list. This email list was chosen because the majority of the suburban Cincinnati fire departments

are of a similar size to Delhi Township. They have similar government structure and budgeting processes. Departments in the region would also have to deal with the same vendors for services on fire trucks. The first part of the survey dealt with demographics of their department, fleet size, and budget. The last part had questions on who they used for service, what services were provided, and if they shared a mechanic with other departments within their political subdivision.

Three personal interviews were conducted to get insider information on the Delhi Township maintenance program. Fire Chief Douglas Campbell of the Delhi Township Fire Department was interviewed. Chief Campbell has a working knowledge of the departments' budget and has the responsibility to make sure that the fire fleet is able to deliver emergency services. Supervisor Mechanic Joe Joyce is the heavy truck mechanic for the township. Joe works for the Delhi Township Public Works Department, and repairs and maintains most of the heavy equipment in the township, including all of the fire trucks. Mechanic Mike Lipps is the light duty mechanic at the Delhi Township Public Works Department. Mike works on the most vehicles between the two mechanics. His main area of responsibility is maintaining all of the cars, and pickup trucks of the township. Most of the township departments use these smaller vehicles, the police department has the largest small vehicle fleet at over 18 cars. Mike is the mechanic who normally services and repairs the fire departments staff cars and ambulances. The two mechanics were asked the same three questions: What is the vehicle maintenance program at Delhi Township doing well? What problems do you see with the Delhi Township maintenance program? What can the Delhi Township maintenance program do to improve?

Limitations

This research had several limitations in the area of literature review, historical data collection, and survey data collection.

The literature review was limited due to the nature of the topic being searched. There are not any fire service manuals related to the management of fire department fleets. Most of the articles published in journals and magazines are targeted to the operator of the fire truck, not the manager of the maintenance program.

Most of the historical data review dealt with the fire department budget, specifically the line items pertaining to vehicle maintenance. Before 2015 vehicle repair expenses were tracked monthly, with all vehicles in one large lump sum account. It would have been difficult to sift through any of this pre-2015 data, so it was excluded. Another issue that arose was that some of the expense data that was entered on the spreadsheets were not easily identifiable as work done by an outside vendor. Further time was needed examining theses sheets closer.

The internal survey (Appendix A) sent to the Delhi Township Fire Department personnel had a better response than was expected. The department historically has a history of poor response to surveys. The external survey (Appendix B) had a disappointing response. The researcher wanted to keep this survey within the local area of Southwest Ohio. A list from the Southwest Ohio Fire Chiefs was used. There are 37 fire departments within Hamilton County Ohio, where Delhi Township is located. There is an equal amount or more of fire departments in the 3 surrounding counties. Out of all of these potential departments that could have responded only 12 took the survey. This low response to the survey limited the data received.

Results

Looking at the NFPA standards was helpful to see if the department was meeting those recommenced standards. NFPA 1911 *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles* had some useful information about the age of the fire fleet. Comparing the age of the fire fleet (Appendix D) to the projected replacement schedule (Appendix C) reveals some possible issues. Engine 233 should be replaced in 2023 and is scheduled to be replaced in 2022. Engine 36 and Engine 30 should have gone to reserve status in 2018, but they are still being used as front-line trucks. According to Table 1, Quint 33 will not go into reserve status and will remain on front-line duty until it is replaced in 2028. The replacement schedule does not mention how the third engine will be replaced.

Table 1 Delhi Fire Department Fire Truck Replacement Dates

Apparatus Name	Year of Manufacture	Current Status	Year to go into reserve per NFPA 1911	Year to replace per NFPA 1911	Replacement date from Appendix C
Engine 233	1998	Reserve	2013	2023	2022
Engine 36	2003	Front-line	2018	2028	2024
Engine 30	2003	Front-line	2018	2028	None Listed
Quint 33	2008	Front-line	2023	2033	2028

The historical data reviewed was from the 2015-2018 budgets. The focus was on finding out what the total amount spent for the year was on maintenance and repairs, how much of that was on outside vendors and how much was used by the township mechanics. All of this information was compiled in Table 2. The outside vendor's row of Table 2 has been split into categories. Tires were separated from the outside vendor row because of the high expense of tires. The township mechanics have never installed new tires on any of the fleet. It is more economical to have the tire vendor install them at the time of sale.

The shared services number for the mechanic's salaries was not included in the table because complete data could not be accurately obtained. Chief Campbell was able to provide the 2018 amount of $77,432 for the heavy truck mechanic and $13,750 for the light duty mechanic. The average of the previous years for both mechanics has been around $80,000. The amount owed for the shared services for the mechanics' wages is based on the previous year's hours works. So wages are paid in arrears. Question 1 of the asked what the annual budget for vehicle repairs was for the DTFD. According to Table 2, DTFD has spent an average of $43,558 over the past 4 years, you add in the average of $80,000 for both of the mechanics' salaries, the total increases to $123,558. On average DTFD is only spending $9000 on outside vendors, and the majority of that money is on tires.

Table 2 DTFD annual maintenance budge

Year	2015	2016	2017	2018	Average
Maintenance and repairs	$31104	$31832	$26264	$49069	$34567
Outside Vendors	$4219	$2189	$4906	$2247	$3390
Tires	$6096	$1299	$4525	$10486	$5601
Total	$10315	$3488	$9431	$12733	$8991
Total maintenance cost for the year	$49419	$35320	$35695	$61801	$43558

(*Delhi Fire Budget 2015*, 2014) (*Delhi Fire Budget 2016*, 2015) (*Delhi Fire Budget 2017*, 2016) (*Delhi Fire Budget 2018*, 2017)

The internal survey titled *Delhi FD Vehicle Maintenance Survey* yielded some surprising results (Appendix A). The response back from the fire personnel was nearly 100%. The first and second question asked if they had been trained in how to perform truck checks and if they had the knowledge to perform small repairs. Out of the 64 responses on 3 people felt that they did not feel like they could check the truck properly or do minor repairs. The third question asked how people knew there was a problem with a truck or pending repairs. The respondents could pick as many as they felt applied to them. The three most common answers were: mechanical check sheets, emails, and a pass along at shift change. Fire Manager was picked by only 43% of the respondents. Fire Manager is the computer program that repair request are entered into by the vehicle operator. All fire personnel have access to this program and are able to query a vehicle to find out all of the problems that it currently has or has pending to be repaired. The fourth question asked if the fire personnel felt that repairs were being completed in a timely manner.

The majority of the fire personnel 79%, somewhat agreed and higher that vehicle repairs were completed in a timely manner. 95% of the respondents strongly agreed, agreed, or somewhat agreed that vehicle repairs were completed correctly and complete. This number reflects the quality of work completed by the township mechanics, and the faith the fire personnel have in their work. The last question asked what could be done to improve vehicle maintenance. Around eight respondents left a comment that people needed a refresher or instructions on how to check the trucks and what was expected of them. The tone of these suggestions seemed to point out that others needed the training and not themselves. Reporting, tracking, and updates when work was completed was also a common request. Several people felt that others were being lazy and not reporting or attempting to fix easy common repairs. Six people requested that the fire department have a dedicated mechanic just for the fire equipment. This survey answers question 4, do the firefighters have confidence that repairs are being completed in a timely and complete manner. The answer is a resounding yes to both.

The survey titled *Fire Department Maintenance*(Appendix B) only had 12 respondents. 58% of the respondents had less than 50 members on their department, 42% had 51-100 members. The number of vehicles in their fleets ranged from less than ten 4%, 11-20 42%, and 21-40 25%. There was a wider spread of answers to how much is your annual vehicle maintenance budget question. Looking at the departments that responded, they are similar in personnel and fleet size to Delhi Township Fire Department. It could have been assumed that these departments would have similarly sized budgets for maintenance, but the results showed otherwise. 25% had a budget of $20,000-$30,000, 25% had a budget of $30,000-$50,000, 25% had a budget of $75,000-$100,000, and 17% had a budget of $100,000-$500,000. It was not asked and no respondents indicated, but it does not appear that anyone uses a shared services

model for paying mechanics in other departments. Outsourcing of repairs was the dominant method of repair. Only one department used a dedicated mechanic or their department. 17% use mechanics that belong to the same local government. The balance indicated they have non-certified firefighters perform the repairs. When repairs were done in-house 100% of the respondents indicated that the mechanics, or firefighter could perform oil changes, tune-ups, tire rotations, and other light repairs. Fire pump/valve replacement and emergency lighting installation were also popular at 70% and 60%. Brake, suspension repair, transmission repair, and diesel engine repair were all ties at 82% that would be sent to an outside vendor for repair. The Delhi Township heavy truck mechanic has performed all of these services in-house but has sent these out to be fixed by outside vendors on occasion. Tire mounting, hydraulic aerial repair, and bodywork round out the most common repairs outsourced at 73%. Nearly all of the tire installation at Delhi Township are sent out to be done because the price of the tires includes the mounting, and if an alignment is needed they do not have the proper equipment. Only two departments use dedicated mechanics, and one of them share this mechanic with two other departments, and the other with three. The other departments that do have the ability to use another departments mechanic have to share it with two other departments 40% of the time, three other departments 40% of the time, and five other departments 20% of the time. Looking at the overall results of this survey, Delhi Township is doing more in-house maintenance than the other departments. The Delhi Township mechanics have the abilities to handle many of the more complex repairs. Many of the larger departments with the larger budgets send the majority of their complex repairs out and only do oil changes and minor repairs in-house.

A personal interview was held with Fire Chief Douglas Campbell to get an insight into the budgetary numbers with vehicle maintenance and the shared services. Chief Campbell

explained that because he pays 81% of the heavy truck mechanic, he would like to hire him from the Public Works Department and then have the other departments pay him the shared services amount when he is used. Chief Campbell feels that he will be able to set the repair priorities better and have more control over how quickly projects are completed. Chief Campbell mentioned that he is working on a plan to move up the purchase of a fire engine by a year or two. (D, Campbell, personal communication, December 20, 2018)

Mike Lipps the light duty mechanic was interviewed for his perspective on vehicle maintenance. Lipps was first asked what he thought was going well for the maintenance program. Lipps indicated that he feels that the mechanics are able to fix a wide variety of issues between the two of them. The mechanics are able to find the best price on quality parts. When asked what he thinks is a problem with the maintenance program, he responded that he feels there is too much work to be completed between the two mechanics. As the mechanic who services nearly all of the small vehicles in the township, he said that his workload increases every time they hire a new position in the township because they have to have a car or truck to drive. Lipps has several suggestions to improve the maintenance program. Lipps stated that they need more help and more money in the budget. He feels that there needs to be better planning, with clear priorities set. Lipps feels that he jumps from vehicle to vehicle and does not have them in an orderly fashion. Lipps is not a fan of Facility Dude, this is a records management system that is used to enter and track work orders for all vehicle repairs township-wide. Lipps feels that it is outdated and clunky to use. (M.Lipps, personal communication, December 20, 2018)

Joe Joyce the supervisor and heavy equipment mechanic had lots of thoughts on the questions asked. Joyce says that he knows the equipment that he repairs because the mechanics

see the same trucks for service and repair. He feels that sending the truck out for repair has the possibility of a different person working on the truck each time. Joyce explained that when a vehicle comes in for a routine service such as an oil change, it takes them longer to complete the job than a quick lube shop or dealership. Joyce said the township mechanics go over the trucks bumper to bumper, looking for issues and even fixing things before they become problems. Joyce explained that lube shops and dealerships are about speed and completing as many cars as possible. The township mechanics are about safety and doing the job correct the first time. Joe said that he takes pride in the equipment and trucks and as a professional strives to do the best job. Joyce explained that there have been issues with outside vendors work not being correct and that the mechanics have had to repair the trucks before sending them back to the fire department. When asked about the problems with the maintenance program Joe Joyce like Mike Lipps feels that the mechanics need more time to work on the trucks. Joyce said that he would like at least 2 weeks with each large vehicle in the township every year. Some vehicles might need more time. Joyce said that sometimes because of time constraints he is only able to fix the safety and operational problems on a truck. Joyce gave an example of why there can be delays in completing work on the trucks. Sometimes the mechanics get pulled away to fix other problems with other vehicles. Not being able to complete one truck at a time causes delays. Joyce mentioned paperwork and documentation as something he wishes he had more time to complete. Keeping track of work orders was also mentioned. Joyce spoke about the age of the fire fleet. He said that because it is getting older, the trucks were requiring more maintenance and the repairs were becoming more frequent. He said he would like to see the department purchase a new pumper sooner than is scheduled. Joyce had several ideas to improve the maintenance program. He feels like they could use more time to work on trucks, and getting overtime approved could

help. He thinks that having additional help would also help things out. Joyce also cautioned that you cannot just hire any mechanic, this person has to be the right fit for this type of work. He said that it is not a matter of having an extra set of hands, but having a quality set. (J. Joyce, personal interview, December 20, 2018)

After examining the surveys and recounting the interviews, some of the logistical problems that need to be fixed have become clear. Both the mechanics and the firefighters report that there are issues with reporting repairs and keeping track of them. Having enough time to complete tasks is an issue. There does not seem to be enough planning with scheduling vehicles in the township. From the firefighter survey, it has been mentioned that there is a desire for training on what is expected with vehicle maintenance and how to do minor repairs. If more firefighters take an active role in maintaining the trucks, it might relive the mechanics from these repairs and give them a little extra time they have been asking for.

Discussion

It is very clear from the literature review that preventive maintenance not only saves money in the long run but keeps the trucks out on the streets making runs. Both the civilian industries and the fire service agree on this point. It is evident from the surveys and feelings of the firefighters that they feel that the work being completed is a quality job.

Joe Joyce mentioned that the township mechanics like to spend extra time on the trucks when they come in for service, speed is not the primary goal. An article from Fleet Owner Magazine titled *Vehicle lifecycles vs. maintenance costs* echoes these same thoughts. One of the tips the article gave was," you can't shotgun a PM program if you really want to reduce your costs...spend three or four hours going through the distinct process making sure a vehicle will run

to the next PM".(Commendatore, 2016) This same concept was found in another article titled Small Fleet's Biggest Challenges. The article mentions that city leaders have questions about why a car cannot be taken to the local quick lube for oil changes. It is explained that many of these quick change shops cannot handle the volume, and their staff is not trained in any mechanics beyond oil changes. In the article, they noted there are times when outsourcing would be wise, especially when dealing with tires, because economically and time wise the government shop will have a hard time competing. (Lubinsky, 2018) The Delhi mechanics have found this same concept to be true. Tires are the largest expense that is outsourced. (Table 2)

Joe Joyce brought up the subject of the fire fleet getting older. He has concerns that the aging fleet is going to be more prone to breakdowns and in turn, take up more of the mechanics time to repair. *NFPA 1911 Standard for the Inspection, Maintenance, Testing and Retirement of In-Service Emergency Vehicles* bolsters Joyce's argument for replacement sooner of the fire trucks. In this standard, they explain that there have been so many changes and improvements in technology and safety that trucks that are older than 15 years old would benefit from being replaced with a new truck. In this standard, they also talk about refurbishing a fire truck. It mentions that refurbishing a truck is not like it was in years past. Because of all the new requirements and advancements in safety and technology, a careful cost-benefit analysis needs to be done. Most of the time it is not worth refurbishing the truck because the price is at or close to the price of a newly bought truck. (*NFPA 1911*, 2017, Chapter D)

The author of this study was very pleased with the results of the internal survey to the firefighters. 95% of the firefighters felt they knew how to perform a truck check for a daily, weekly, and monthly inspection. Nearly the same amount felt they would be able to tackle light repairs on the trucks. Reading into the comments in Appendix A, it shows that the firefighters are

not doing the repairs though. They also do not have faith that other firefighters will attempt these small repairs. The majority of the firefighters felt that the fire trucks are being repaired and maintained in a timely manner. The overall satisfaction among the firefighters shows that they believe that the trucks are coming back to them repaired correctly. When asked in the survey several firefighters made comments that refresher training in vehicle checks and light repairs would be helpful. This is an easy request to fulfill.

During the interviews with the two mechanics, they both mentioned that there were issues with tracking repairs and what needed to be done. They were both dissatisfied with the current software management system. The firefighters' complaint about the system that they use is that they do not have any feedback about if repairs requests are acknowledged, and when they are complete, what was repaired. Neither the mechanics nor the firefighters use the same reporting system, there is a feeling between both that issues with trucks are getting lost. If firefighters feel that they are reporting problems and they are being ignored, they will become apathetic and stop reporting maintenance issues.

One of the problems this research paper examined was if there were delays in getting repairs completed in a timely manner. The survey shows that the large majority of firefighters feel the repairs are completed in a timely manner. The two mechanics feel differently. They might be getting the repairs done and the trucks out the door, but both have the feeling that they would like to spend more time with the truck, fixing outstanding issues, performing predictive maintenance, or upgrades to the trucks. The workload is obviously too much for just two mechanics. There will come a time when there are more broken vehicles than the two mechanics can handle at once.

One of the concerns this paper wanted to examine was the financial impact of sending vehicles out to be repaired by outside vendors. Just looking at the annual expenditures over the past 4 years, it appears that the spending with outside vendors is reasonable. The majority spent with outside vendors is for tires. The township mechanics do not install tires, and good tires are a safety item that cannot be deferred. According to Table 2 the department spends around $5600 on tires a year. The balance of outside vendors is $3400, with a combined total of approximately $9000 annually. The concern arises from the fact, that if either one of the mechanics are unable to repair the truck because they are too busy, don't have the proper tools or training, the department could run out of money in the repair budget. In 2018 $91,000 was paid to shared services for mechanics wages. This $91,000 is based on the hourly work the mechanics performed in 2017, but its paid in 2018. The $91,000 is not available to pay outside vendors, only the money in the repair accounts can be used to pay them. In the past when repairs needed to be sent to outside vendors at the end of the fiscal year and there was no money in the repair budget left, money had to be transferred in from other accounts. This is not a good way to financially run the department. When money is shifted from other accounts, those accounts suffer and goods and services they were intended for do not get purchased.

Recommendations

1. Conduct a refresher training on how to perform a daily, weekly and monthly check on the fire trucks. This training outline can also be used for the basis to train new employees.

2. Both the firefighters and the mechanics mentioned that a better records management system could help with reporting problems, tracking problems, and knowing when the problem has been repaired and what the final outcome of the repair was.

3. Scheduling and prioritization of all township vehicle repairs should be done as a group effort if both mechanics are going to be shared among all the departments. A monthly or bi-weekly meeting should be held by all parties responsible for vehicle maintenance. Having a clear plan will reduce interruptions in repairs, and allow for better scheduling of operations for all.

4. The vehicle replacement schedule needs to be re-examined. Funding for the fire engine that should be replaced in 2028 needs to be found. It would be optimal to space the replacement of the engines to five years, so you are not having to buy two at the same time, or close together.

5. Allow the fire department to hire the heavy truck mechanic full time. The fire department already pays for 82% of his wages, he would also do the work the light duty mechanic performed for the fire department.

Recommendations for the organization and future readers who are researching fire department fleet management programs:

1. Evaluate your entire fleet replacement schedule including staff cars and ambulances not just larger trucks.

2. Examine what the succession plan is for the fleet mechanics. Are there internal candidates who can be sent to training to specialize in fire truck repair, or will you have to look to the outside job market?

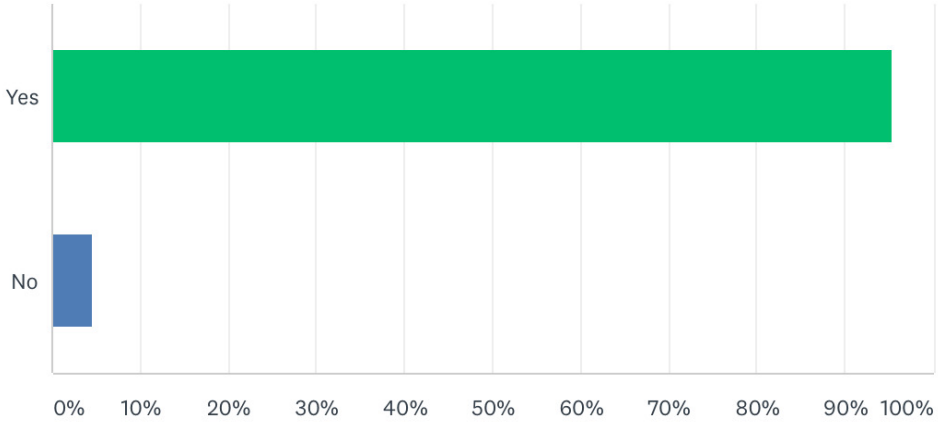
3. Cultivate positive relationships with your mechanics, include them in on your apparatus committees. Their input on specifying new vehicles could save the department lots of money.

Appendix A: Delhi FD Vehicle Maintenance Survey

Q1

I have been trained or have the knowledge to perform daily, weekly, and monthly mechanical checks on the vehicles I am certified to operate?

Answered: 64 Skipped: 0



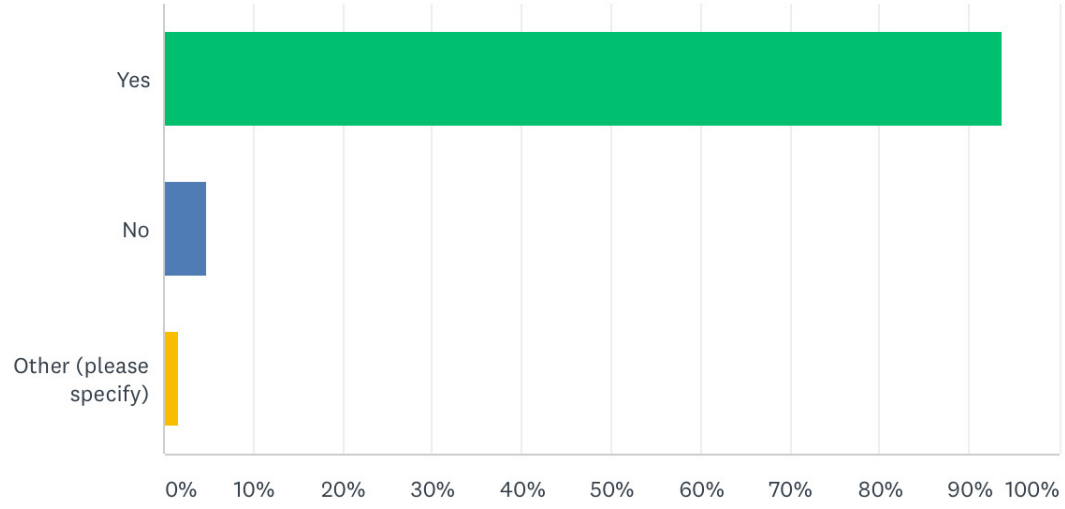
ANSWER CHOICES	RESPONSES	
Yes	95.31%	61
No	4.69%	3
TOTAL		64

Figure 1. Question 1

Q2

I have the knowledge or training to perform small repairs on the vehicles such as: light bulb changes, tightening bolts and minor repairs?

Answered: 63 Skipped: 1



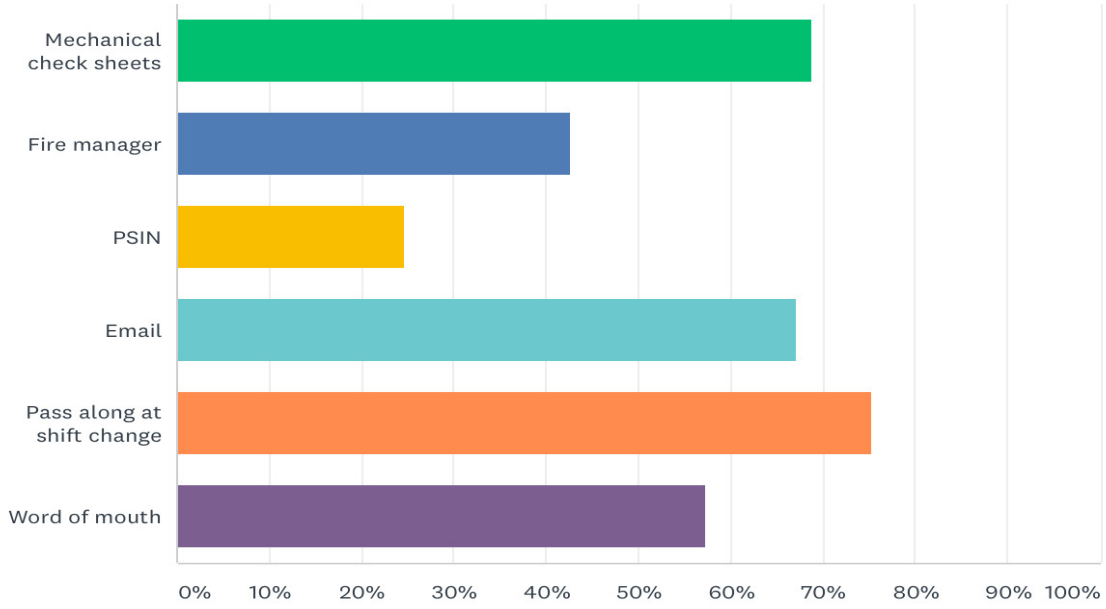
ANSWER CHOICES	RESPONSES	
Yes	93.65%	59
No	4.76%	3
Other (please specify)	1.59%	1
TOTAL		63

Figure 2. Question 2

Q3

I know what is wrong with a vehicle or, the repairs to be done by: check all that apply

Answered: 61 Skipped: 3



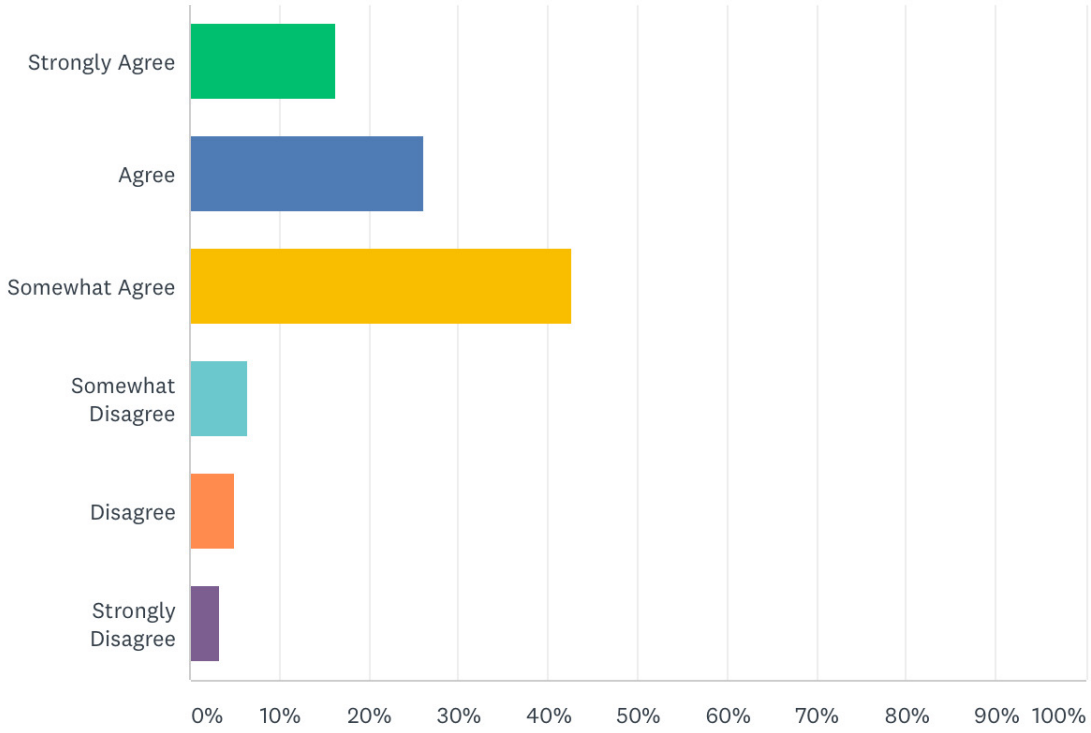
ANSWER CHOICES	RESPONSES	
Mechanical check sheets	68.85%	42
Fire manager	42.62%	26
PSIN	24.59%	15
Email	67.21%	41
Pass along at shift change	75.41%	46
Word of mouth	57.38%	35
Total Respondents: 61		

Figure 3. Question 3

Q4

Vehicle repairs are completed in a timely manner

Answered: 61 Skipped: 3



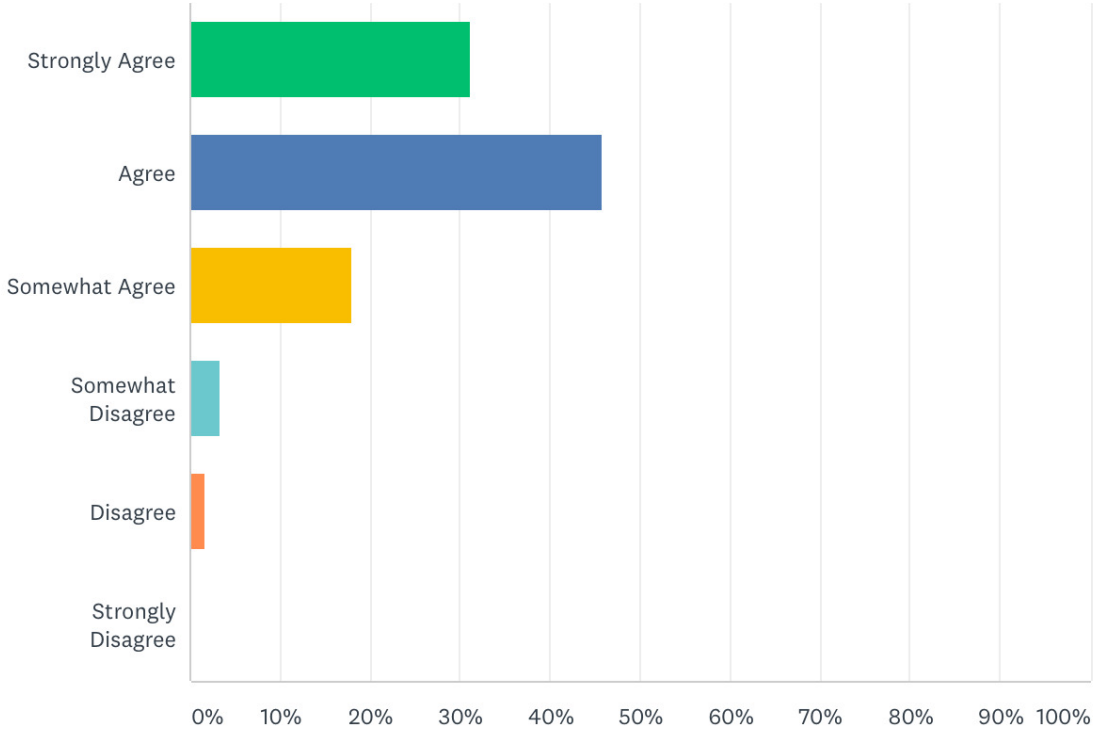
ANSWER CHOICES	RESPONSES	
Strongly Agree	16.39%	10
Agree	26.23%	16
Somewhat Agree	42.62%	26
Somewhat Disagree	6.56%	4
Disagree	4.92%	3
Strongly Disagree	3.28%	2
TOTAL		61

Figure 4. Question 4

Q5

Vehicle repairs are completed correctly and complete

Answered: 61 Skipped: 3



ANSWER CHOICES	RESPONSES	
Strongly Agree	31.15%	19
Agree	45.90%	28
Somewhat Agree	18.03%	11
Somewhat Disagree	3.28%	2
Disagree	1.64%	1
Strongly Disagree	0.00%	0
TOTAL		**61**

Figure 5. Question 5

Question 6

What could be done to improve vehicle maintenance?

1. More of a log so we know and don't have to ask over and over

2. Ticketing system from vendors that would indicate when parts are ordered, parts are received, and then when work is scheduled to be performed.

3. Better reporting of the issues to the officer on duty or electronically

4. Hire More Staff and make vehicle maintenance a very high priority

5. Things seem to be running smoothly

6. I believe everything we can do is being done

7. Resource Binder that walks you step by step on each vehicle for new employees and for a refresher

8. more unified system that shows prior maintenance issues found and reported.

9. Train more personnel on routine maintenance

10. To actually have the issue reported.

11. hire a full-time mechanic who is certified

12. Nothing I can think of.

13. Members could quit being lazy and fix miniscule problems IE light bulbs!!! And know where parts are to fix issues. LIGHT BULBS IN THE TOOL ROOM

14. If the employees would take care of the squads like they do with their own vehicles.

15. Teaching everyone to know the vehicles they are responsible for inside and out

16. Give all firefighters an overview of how things work

17. Budget for and fund the program appropriately

18. Find a way to free up Joe, especially in the winter months.

19. I didn't know there was a problem, so because of that, I would say stick with what we are doing.

20. Communicate the repairs that have been completed on said equipment. Putting the check sheets in the vehicles no the office due to sheets not the following equipment during

switch out. log book in the equipment that outlines the needed small repairs and when they are completed remove the entry.

21. Have the guys try to fix what's they are writing up. Take pride in your trucks. It's to easy to write it up and forget it.

22. None

23. The current "truck bosses" and other operators need to take more ownership for their vehicles. I personally have noticed a more relaxed attitude toward tool and vehicle maintenance lately and as such our tools and equipment are beginning to age prematurely.

24. A mechanic that only works on our stuff so we can be the main priority.

25. Maybe make a weekly training a few times a year on maintenance tips or procedures. I'm sure everyone could use a refresher

26. I don't know what the answer is, but it seems like our vehicles, more specifically our trucks, go out of service a lot. It feels like when they're oos its always for way longer than stated. Is our truck going oos service to sit in a lot when it could still be in service until whoever is ready to work on it? Also, frequently switching vehicles can cause equipment to be forgotten or misplaced.

27. quicker turnaround time.

28. Outsourcing of minor repairs and apM services- our mechanics are “too busy” for such tasks

Appendix B: Fire Department Maintenance Survey

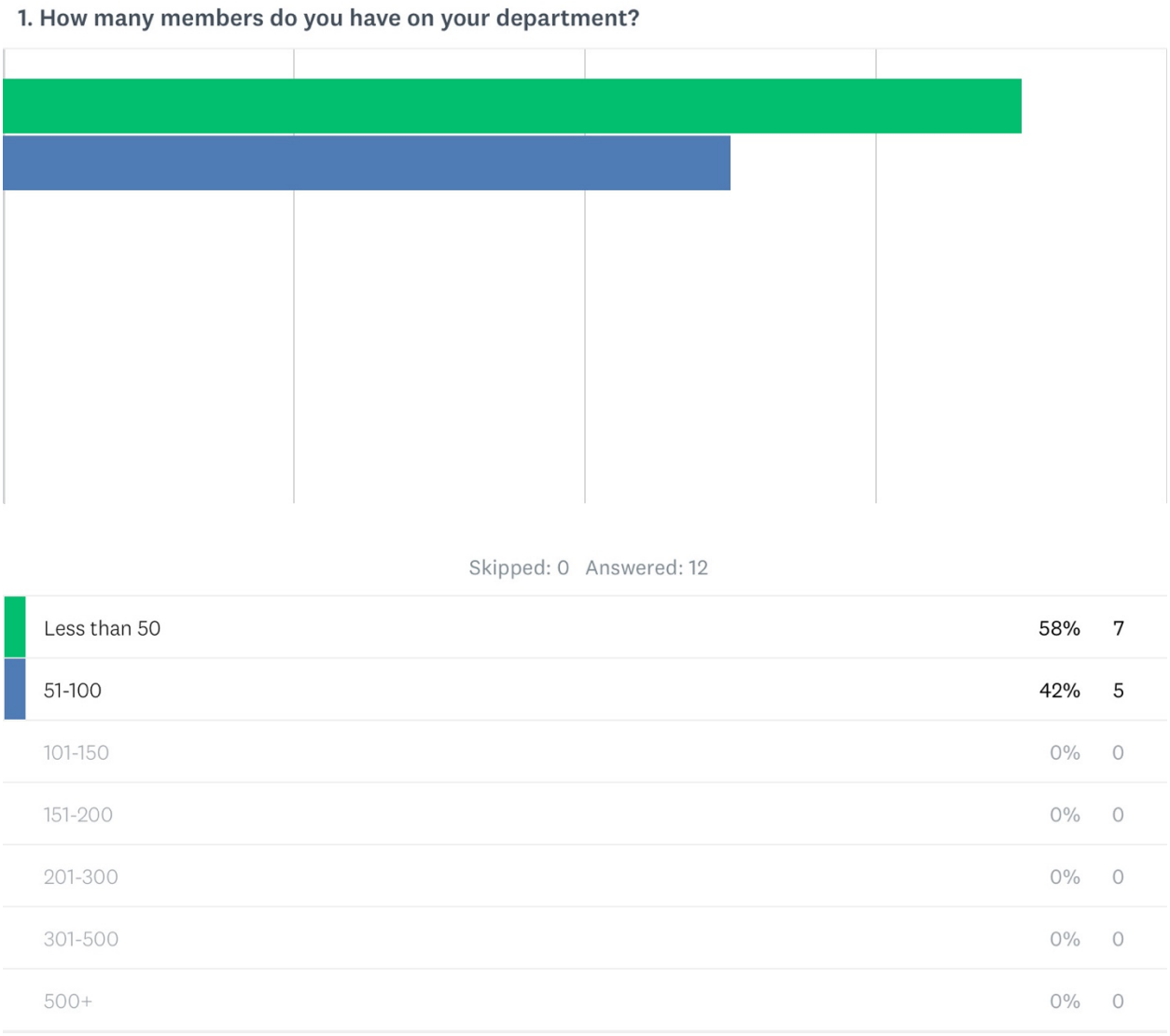


Figure 6. Question 1

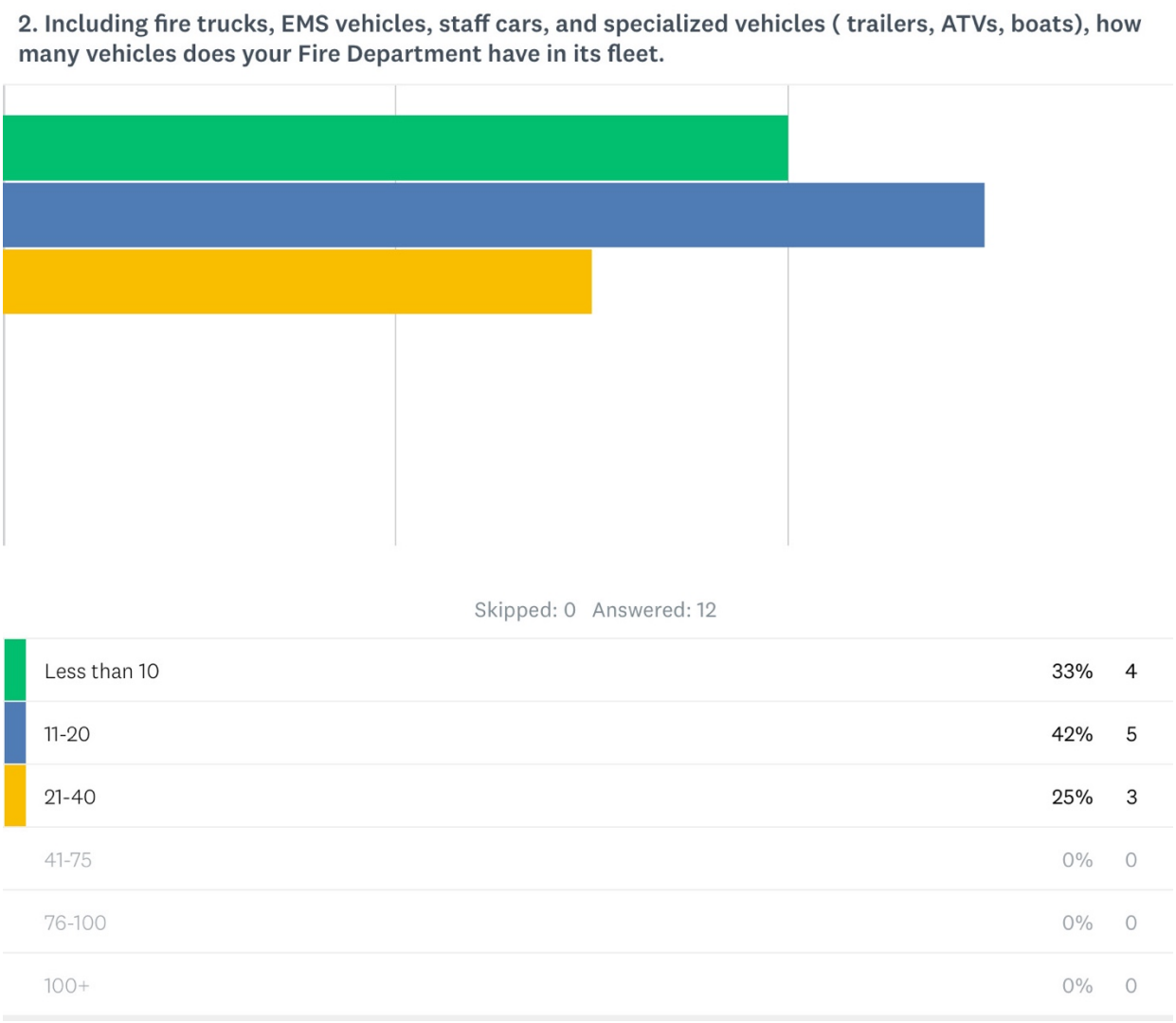


Figure 7. Question 2

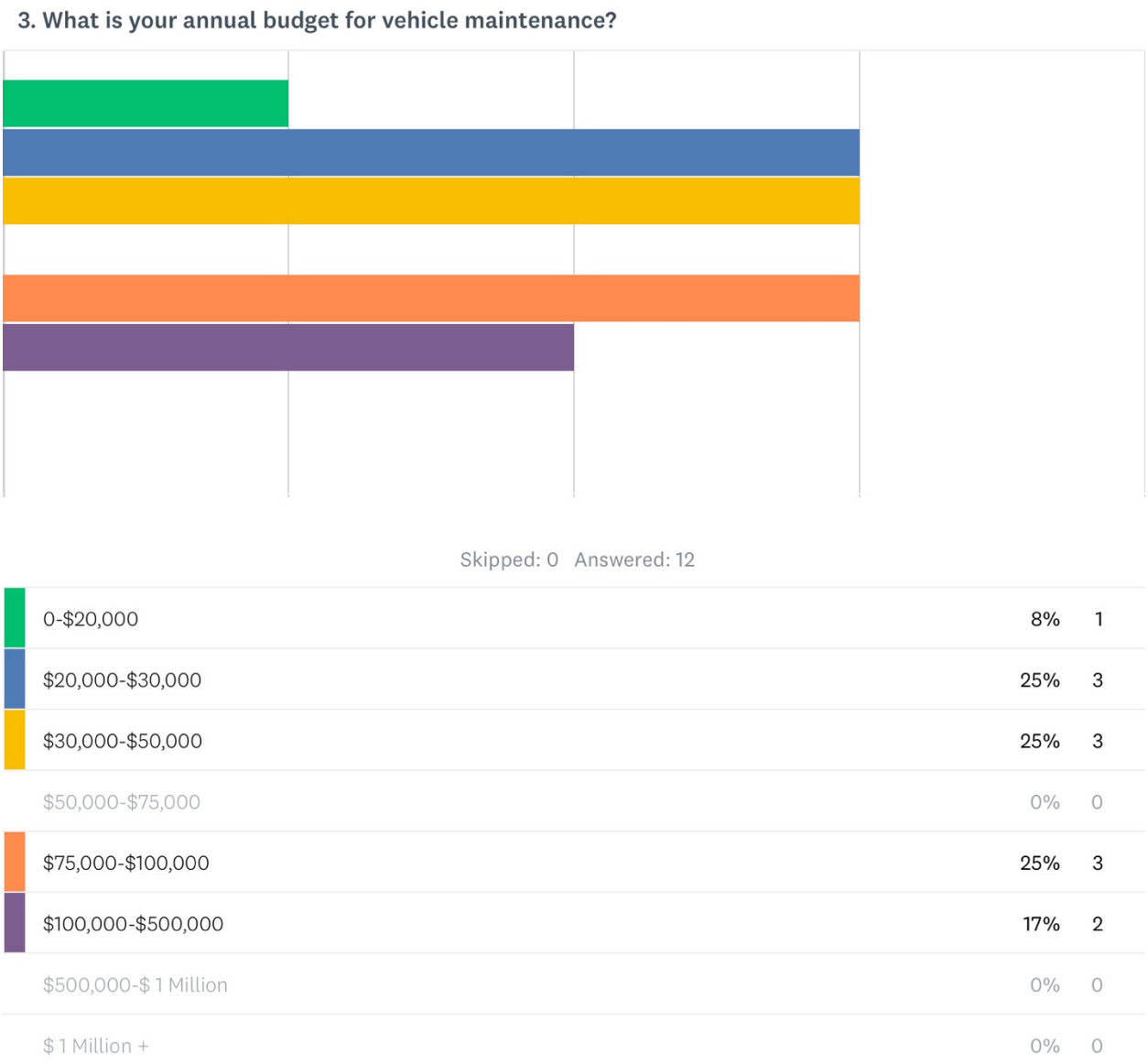


Figure 8. Question 3

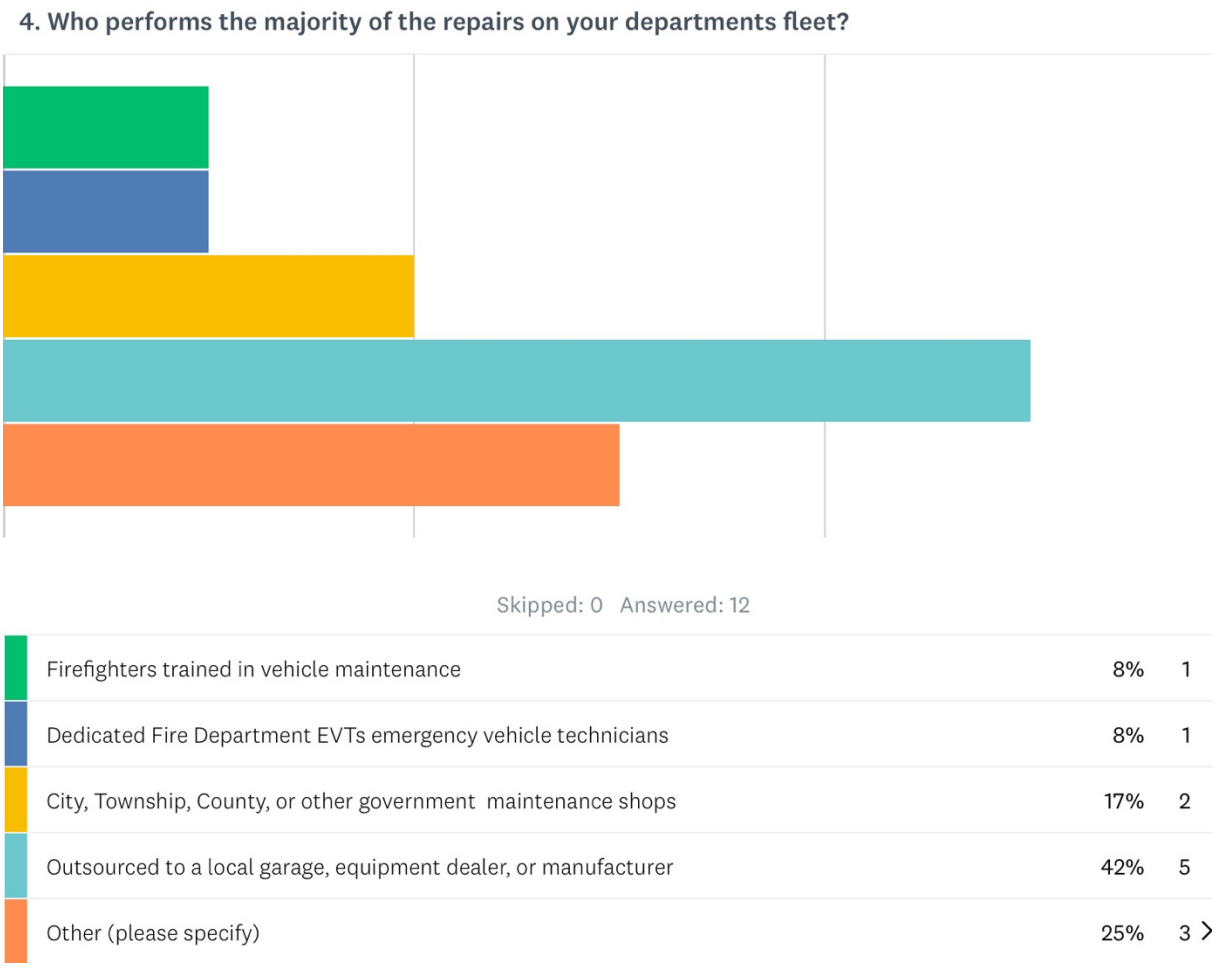


Figure 9. Question 4

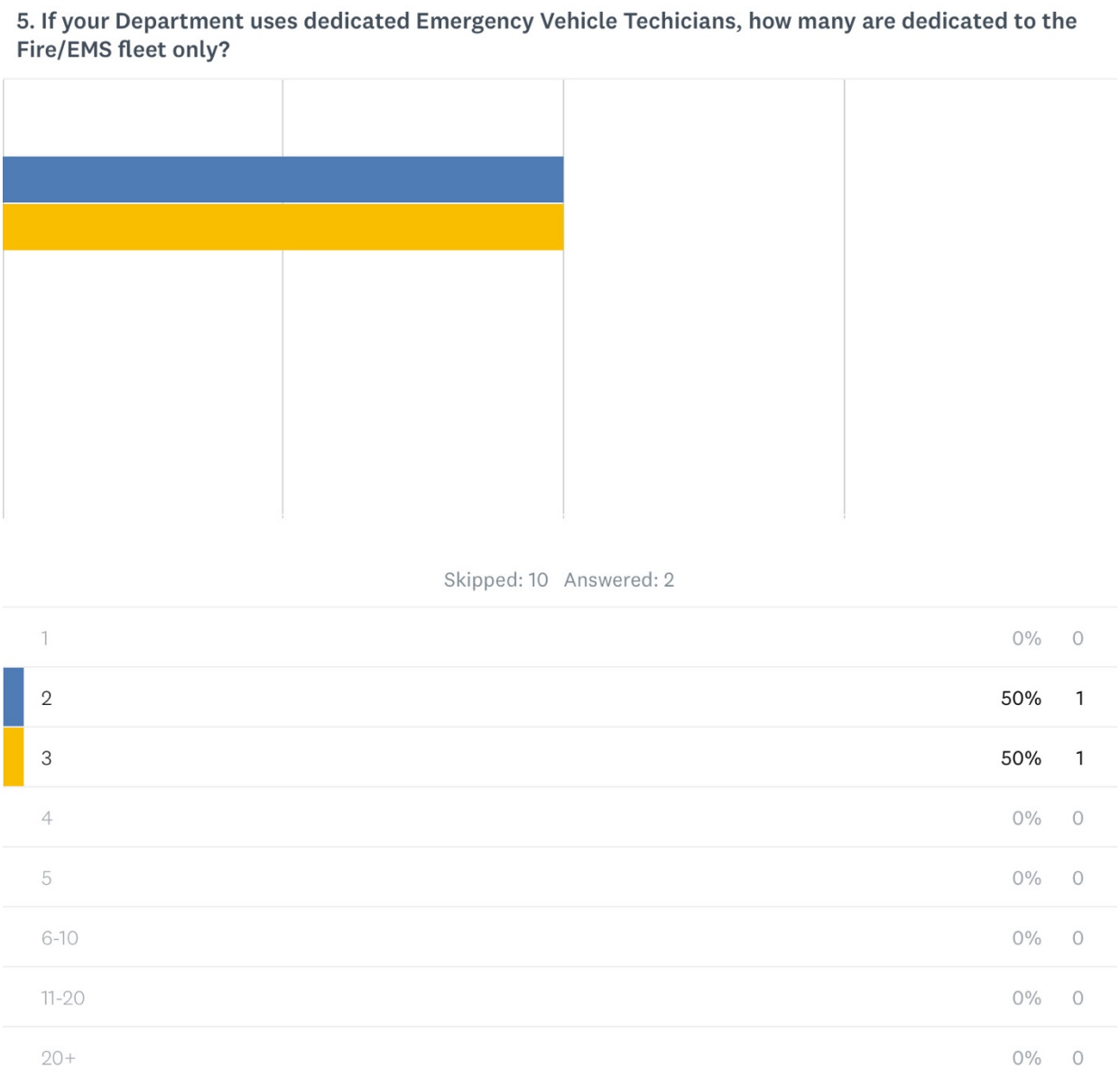


Figure 10. Question 5

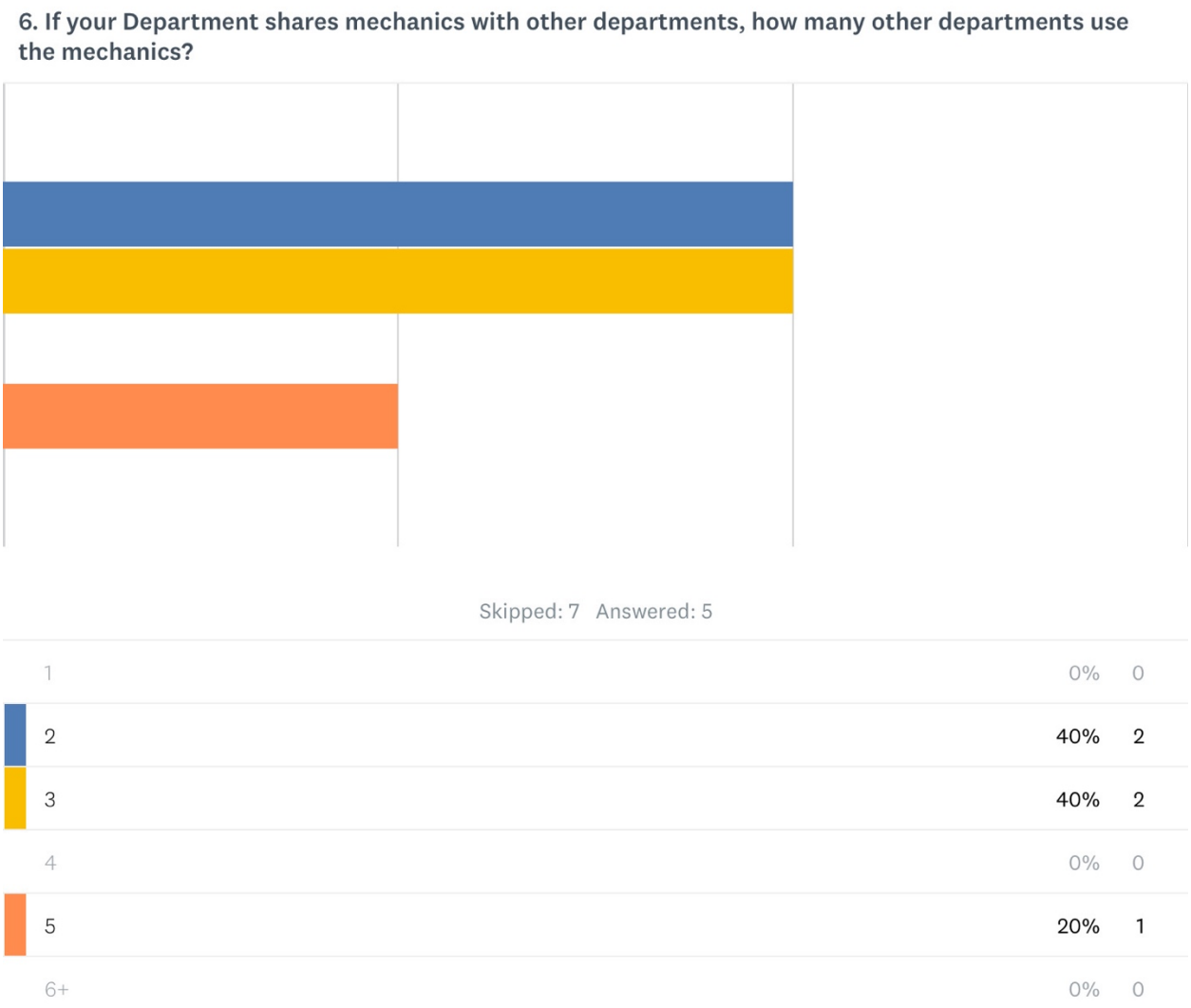
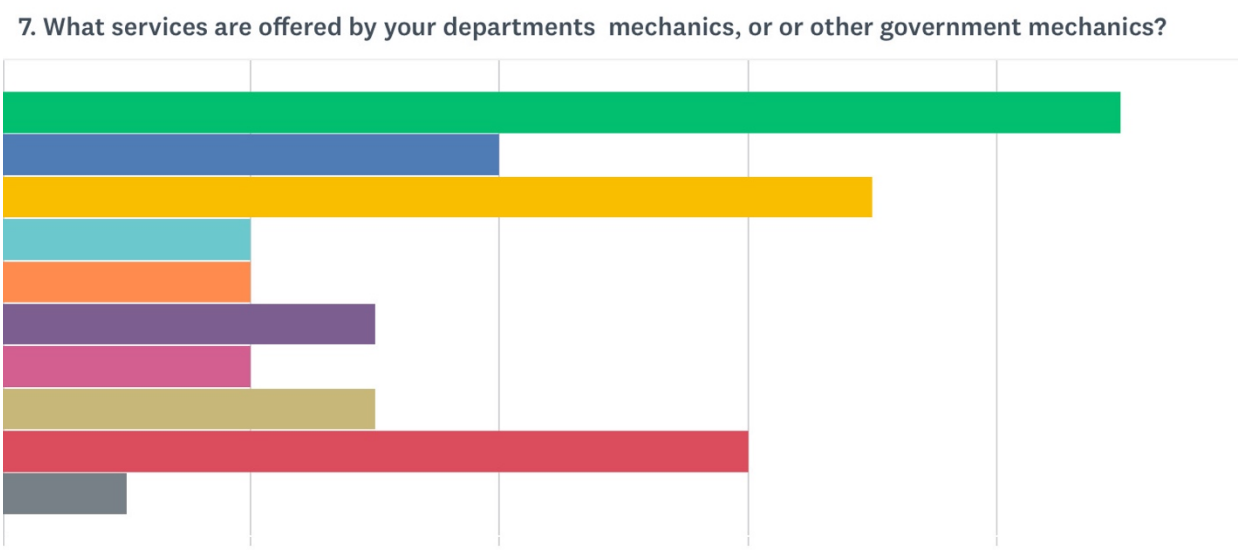


Figure 11. Question 6



Skipped: 2 Answered: 10

Oil changes, tuneup, tire rotation, light repairs	90%	9
Tire mounting and balancing	40%	4
Fire pump and valve repair	70%	7
Hydraulic Aerial Ladder repair	20%	2
Brake and suspension service on large trucks	20%	2
Transmission repair	30%	3
Heavy Diesel engine repair	20%	2
Body work, including painting and decals	30%	3
Emergency light, and electronic installation	60%	6
None	10%	1
Other (please specify)		1

Figure 12. Question 7

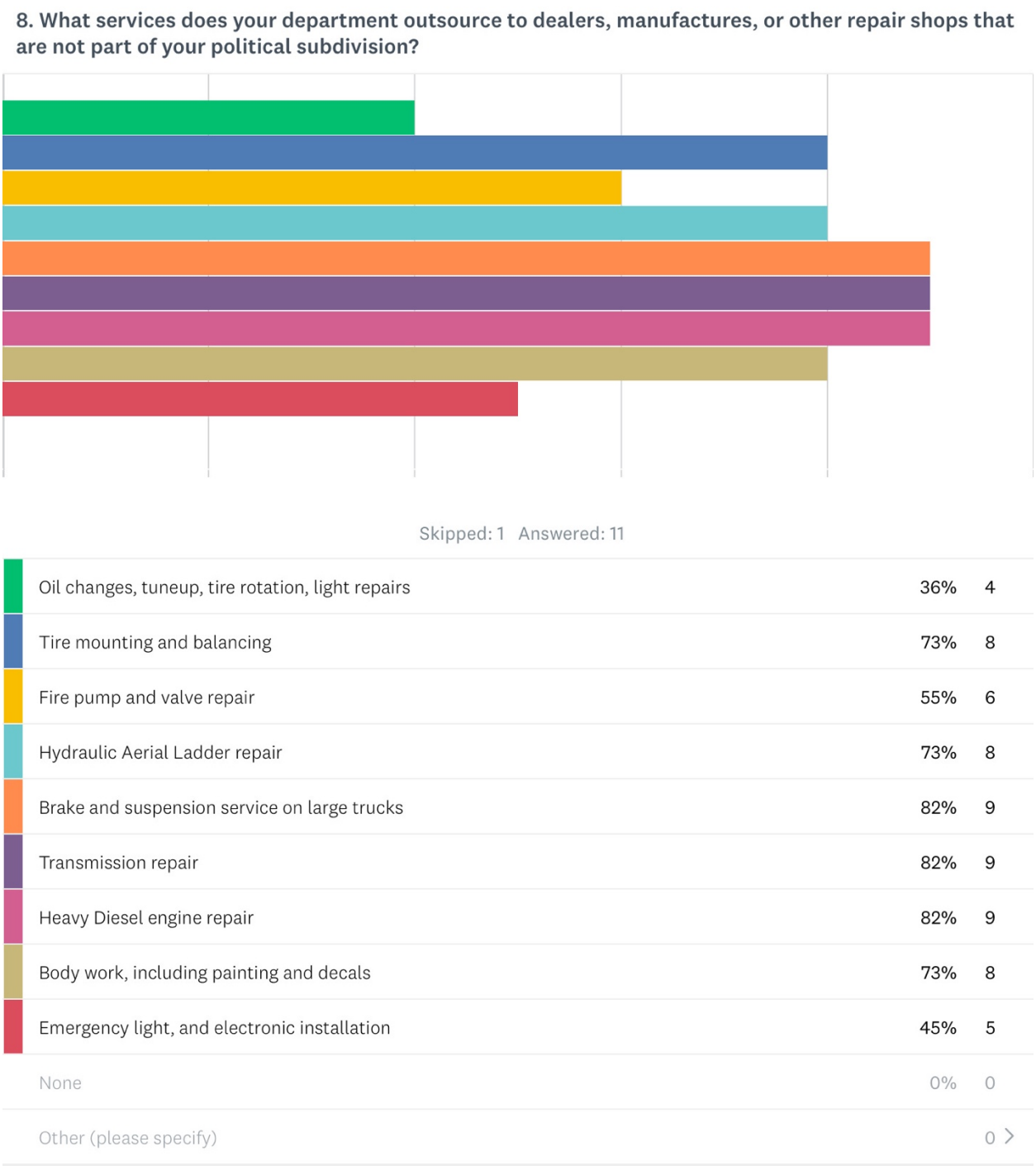
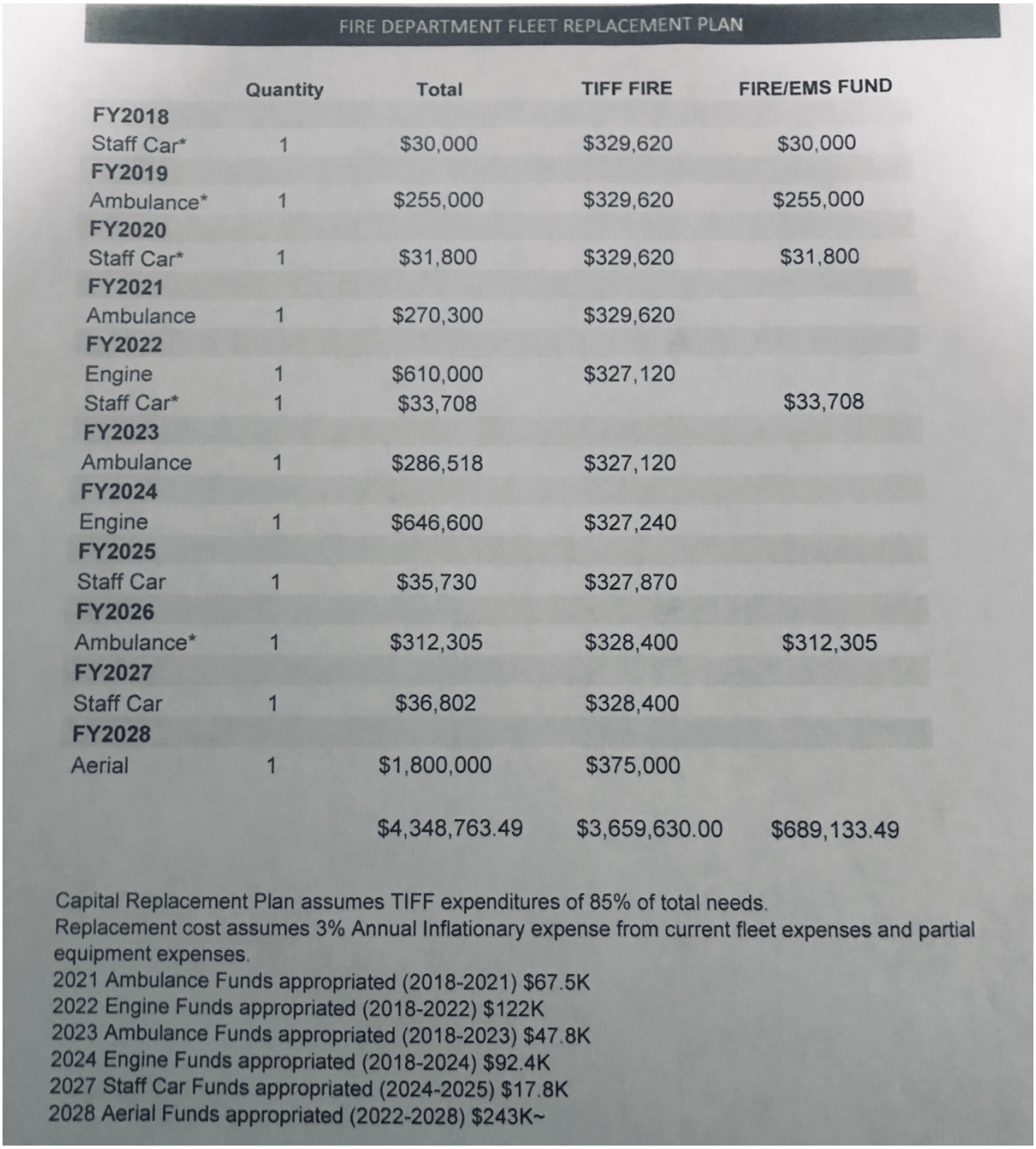


Figure 13. Question 8

Appendix C: Delhi Township Fire Fleet Replacement Plan



FIRE DEPARTMENT FLEET REPLACEMENT PLAN

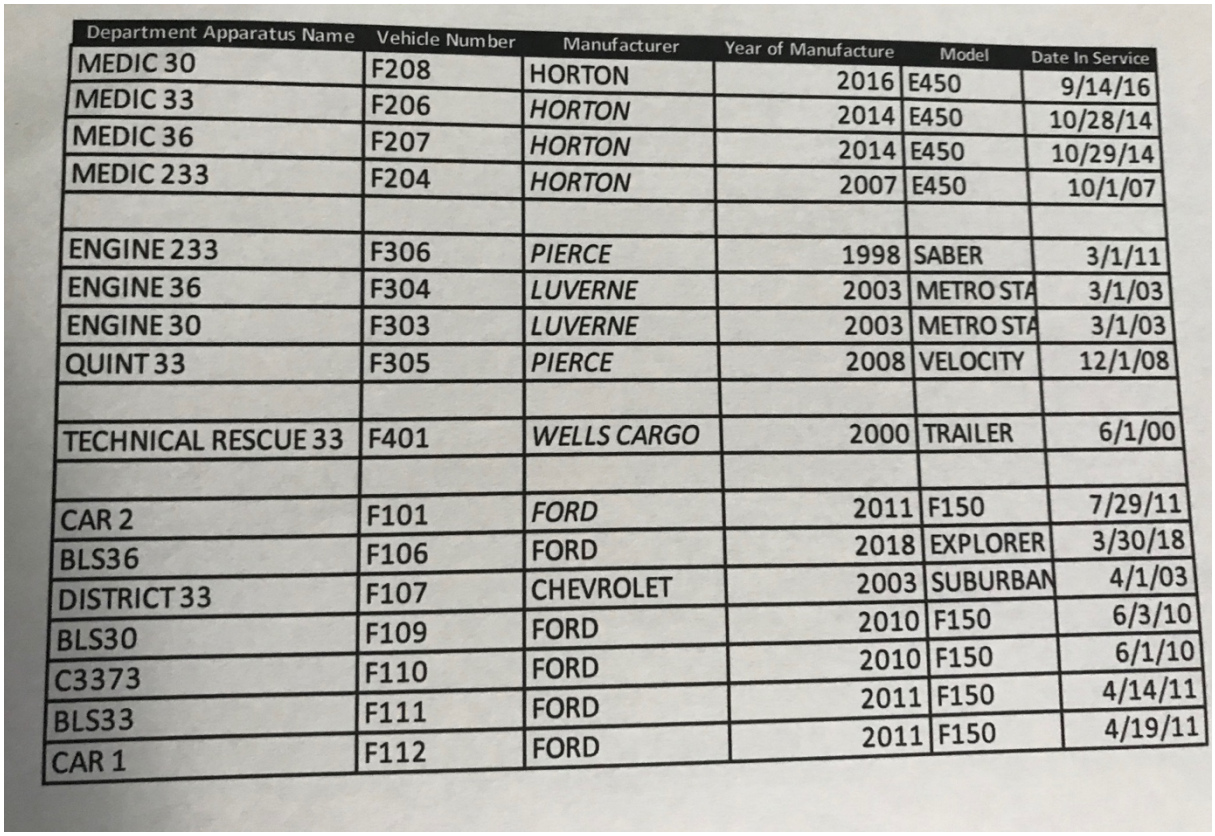
	Quantity	Total	TIFF FIRE	FIRE/EMS FUND
FY2018				
Staff Car*	1	$30,000	$329,620	$30,000
FY2019				
Ambulance*	1	$255,000	$329,620	$255,000
FY2020				
Staff Car*	1	$31,800	$329,620	$31,800
FY2021				
Ambulance	1	$270,300	$329,620	
FY2022				
Engine	1	$610,000	$327,120	
Staff Car*	1	$33,708		$33,708
FY2023				
Ambulance	1	$286,518	$327,120	
FY2024				
Engine	1	$646,600	$327,240	
FY2025				
Staff Car	1	$35,730	$327,870	
FY2026				
Ambulance*	1	$312,305	$328,400	$312,305
FY2027				
Staff Car	1	$36,802	$328,400	
FY2028				
Aerial	1	$1,800,000	$375,000	
		$4,348,763.49	$3,659,630.00	$689,133.49

Capital Replacement Plan assumes TIFF expenditures of 85% of total needs.
Replacement cost assumes 3% Annual Inflationary expense from current fleet expenses and partial equipment expenses.
2021 Ambulance Funds appropriated (2018-2021) $67.5K
2022 Engine Funds appropriated (2018-2022) $122K
2023 Ambulance Funds appropriated (2018-2023) $47.8K
2024 Engine Funds appropriated (2018-2024) $92.4K
2027 Staff Car Funds appropriated (2024-2025) $17.8K
2028 Aerial Funds appropriated (2022-2028) $243K~

Figure 14. Delhi Township Fleet Replacement Plan

(Campbell, 2017, figure 14)

Appendix D: Delhi Township Apparatus Inventory



Department Apparatus Name	Vehicle Number	Manufacturer	Year of Manufacture	Model	Date In Service
MEDIC 30	F208	HORTON	2016	E450	9/14/16
MEDIC 33	F206	HORTON	2014	E450	10/28/14
MEDIC 36	F207	HORTON	2014	E450	10/29/14
MEDIC 233	F204	HORTON	2007	E450	10/1/07
ENGINE 233	F306	PIERCE	1998	SABER	3/1/11
ENGINE 36	F304	LUVERNE	2003	METRO STA	3/1/03
ENGINE 30	F303	LUVERNE	2003	METRO STA	3/1/03
QUINT 33	F305	PIERCE	2008	VELOCITY	12/1/08
TECHNICAL RESCUE 33	F401	WELLS CARGO	2000	TRAILER	6/1/00
CAR 2	F101	FORD	2011	F150	7/29/11
BLS36	F106	FORD	2018	EXPLORER	3/30/18
DISTRICT 33	F107	CHEVROLET	2003	SUBURBAN	4/1/03
BLS30	F109	FORD	2010	F150	6/3/10
C3373	F110	FORD	2010	F150	6/1/10
BLS33	F111	FORD	2011	F150	4/14/11
CAR 1	F112	FORD	2011	F150	4/19/11

Figure 15. Delhi Township Apparatus Inventory

(Helmes, 2018, figure 15)

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