UNIVERSITY OF EDUCATION, WINNEBA

PREVENTION OF ACCIDENTS THROUGH EFFECTIVE AND EFFICIENT MAINTENANCE AND REPAIR WORK IN VARIOUS GARAGES IN ACCRA

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DEDICATION

I dedicated this dissertation to Almighty God for his abundant Grace and enablement, and to my beloved parents Mr&Mrs. Stephen Kwasi Salakpi, for their natural love, care and sacrifices which have made my education possible. I further dedicate it to my wife Antoinette Esi Abiegielee for her encouragement and being supportive, and to my brothers and sisters.

DECLARATION

STUDENT'S DECLARATION

I SYLVANUS STANISLAV SALAKPI, declare that this action Dissertation, with the exception of quotations and references contained in the published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

STUDENT"SSIGNATURE…….....

DATE…….....

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba.

NAME MR. M. K. TSORGALI

SUPERVISOR"S SIGNATURE…….....

DATE…….....

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ABSTRACT

The National Road Safety Commission (NRSC) announced that there were 2,330 road accidents bringing it to an average of accident per day across the country in2011. In 2012, by November ending 13,535 vehicles crashes have been recorded resulting over 2, 069 deaths in Ghana. In December 2012 alone 246 people died and 1, 260 were injured in road accidents. Road accidents being multidisciplinary in nature involve attention of multidepartment such as Ghana Highway Authority for roads and its furniture. Motor traffic transport unit (MTTU), National Road Safety Commission (NRSC). Motor vehicles including drivers, and garages for repair and maintenance.This study investigated the extent of prevention of accident through effective and efficient maintenance and repair work of vehicles in Accra garages. The vehicle maintenance procedures were examined and the vehicle maintenance and repairs procedures were analysed for effective and efficient maintenance and repairs.It was found out that, with the exception of new vehicle dealership that has modern equipment; independent garages have inferior and obsolete equipment to test for engine pressures, check for correct torque of engine, gauges, alignment and engine tune up.The dissertation further showed that mechanics in independent garages do not have the matching skill competencies needed to cope up with the accelerated technology, in the automotive industry drivers lacked maintenance culture which is militating against smooth operations of vehicles.The study also showed that most mechanics and vehicle users are ignorant about the technical details of maintenance, that vehicle first and foremost operates in line with scientific principles. The study recommended that mechanism be put in place to organize a technical training programme for mechanics. Garage owners should procure the diagnostic tools and equipment, and be trained on how to use them to diagnose vehicle. Drivers and vehicle licensing Authority are to ensure that vehicles used on our roads are roadworthy.

CHAPTER ONE

Introduction

1.1 Background to the Study

Industry consolidation and worldwide competition are putting today‟s fleets of vehicles under intense financial pressure; subsequently, operations and maintenance budgets are among the first to be cut. Fewer personnel working at lesser hours are expected to operate and maintain more equipment at lower cost, while also delivering higher throughput, higher availability, and higher profits with aging assets Emerson, (2003). Vehicle maintenance is often regarded as a necessary expense that belongs to the operating budget. With asset availability and reliability becoming critical issues in capital-intensive operations, the strategic importance of maintenance in this business should be recognized.

According to the British Standards Institution (BS 3611, 1984), maintenance is the combination of all technical and administrative actions, intended to retain an item in or restore it to a state in which it can perform its required functions. Clifton, (2006)“Also defined maintenance as any work undertaken in order to keep or restore a facility to any acceptable standard”.

The actual schedule of vehicle maintenance varies depending on the year, make, and model of a vehicle, its driving conditions and driver‟s behaviour. Vehicle manufacturers‟ recommend that the ideal service schedule be based on impact parameters such as:

- Number of trips and distance travelled per trip per day.
- Extreme hot or cold climate conditions.
- Mountainous, dusty or de-iced roads.
- Heavy stop-and-go verses long-distance cruising.

- Towing a trailer or other heavy load.

In modern vehicles, where electronics control most of the vehicle's functions, the traditional tune-up doesn't apply anymore. Tune-up is a maintenance job by which one gets the engine's performance back on track. Today embedded software takes care of it by constantly checking thousands of sensor signals, compensating for worn-out spark plugs, clogged filters, etc. The limp-home function, for instance, allows driving on limited power when the engine is in trouble Maxprogh, (2012). Also, due to the numerous diversities associated with vehicle manufacturing technique per each manufacturing company, it has become increasingly more difficult to determine effective techniques to ensure the identification of maintenance deficiencies which correlate to vehicle maintenance along the millions of existing vehicles.

Transportation plays a major role in the economic development of every nation. In Ghana, however, a lot of vehicles acquired for transportation often get involved in accidents due to lack of effective and efficient vehicle maintenance causing vehicular mechanism to fail hence leading to loss of lives and properties. This situation brings untold burden on the nation and for that matter on the human race.

Apart from accidents, the lack of effective and efficient maintenance also renders the services for which these vehicles are acquired when they break down, rendering the vehicle inefficient and causing financial loss to the owner and the nation.

It is against this background that, the researcher sought to undertake this dissertation so as to propose effective maintenance procedures and standards that will minimise frequent breakdowns and accidents on the roads in Ghana.

1.2 Statement of the Problem

The effectiveness of vehicle maintenance can make the difference between success and failure, between crumpling financially and organizational excellence. Making the right decisions that relate to maintenance will enable businesses to rise to the challenge of the new business planning and strategies. Poor vehicle maintenance is an important contributor to road traffic accidents. The National Road Safety Commission‟s report for the year 2012 shows that2,413 lives were lost through road accidents in Ghana with the highest in Accra.

The high accident records in recent times are indications that, effective and efficient maintenance of vehicles are lacking. While most of the new vehicle dealers have very good service workshops, with which they repair modern vehicles which are of high technology, fleet operators have not-so-good garages; they are not-so-well equipped with modern equipment for maintenance that they use for maintenance services. Hence, with the advent of sophisticated technology in the automobile industry, it is difficult for most of the fleet garages to accurately diagnose and rectify faults, thus resulting in many breakdown vehicles or unsafe vehicles are involved in accident. The inability to provide good maintenance services by these fleet operators affects both government and non-governmental organizations.

Another problem is non-availability and non-affordability of genuine spare parts for effective and efficient maintenance services of vehicles in the garages in Accra. Vehicle owners therefore resort to take their vehicles to independent garages so that used parts can be looked for in the local market or sometimes those needed parts are fabricated by mechanics which do not fit the mechanism of the vehicle very well. Mostly spare parts purchased in the local markets are fake spare parts. It is against this background that, the researcher sought to undertake this study of prevention of accidents through effective and efficient vehicle

maintenance and repairs so as to propose measures to improve vehicle maintenance in various garages in Accra.

1.3 Aim and Research Objectives

The aim of this study is the extent to which the effectiveness and efficient way of automotive vehicle maintenance and repair work services carried out in our various workshops to prevent vehicular accident on our roads.

The objectives of the dissertation are:

1. To examine vehicle maintenance procedures and its effect on road safety.
2. To analyse vehicle periodic maintenance and repair procedures being carried out in various garages in Accra.
3. To develop an effective and efficient maintenance and repair work schedule for the garages in Accra.

1.4 Research Questions

The focus of this research is to answer the following questions:

1. How can effective vehicle maintenance reduce road accidents in the country?
2. What are the standard operation procedures in carrying out preventive maintenance works in the automobile after sales industry?
3. What effective and efficient maintenance and repair work schedule can be developed for garages in Accra?

1.5 Significance of the Study

The significance of the studies are:

- Vehicular accident will be minimized on our roads, if the important function of effective and efficient practice of periodic maintenance and repair services of vehicles in the garages is realized.
- Keeping vehicles in optimal conditions and preventing breakdowns are the effective means to meet the ever societal challenges of vehicle pollution control and accident prevention.
- Since vehicle acquisition is capital intensive, vehicle owners and companies can make meaningful use of its resources when measures are put in place to ensure that vehicles are properly maintained.
- This will also help in addressing environmental pollution caused by emission of combustion product into the atmosphere if the vehicles are well maintained.

1.6 Scope of the Project Study

The project focused on prevention of accidents through effective and efficient maintenance and repair work in various garages. The study was conducted at various workshops in Accra, and it involved the analysis of vehicle maintenance practices in those workshops. Four specific areas including new dealership workshops, fleet operator garages, independent garages, and services stations were covered. Due to time and money constraint the project was confined to some selected garages in only Accra.

1.7 Organisation of the Study

This dissertation is divided into five chapters. Chapter one introduced the thesis by providing the background information to the study. It also discussed the research problem, research objectives and research questions. A brief overview of research methods as well as the significance and scope of the study are also addressed.

Chapter two addresses types of wear, maintenance, diagnosis, vehicle maintenance facilities, and service manuals. It also includes a review of the literature on the periodic maintenance procedures, automobile service business, and vehicle control system.

Chapter three presents the conceptual framework and research methods for this study. The chapter starts making a clarification of the concepts used in this thesis. It then presents the conceptual framework for the study. The chapter concludes by illustrating data collection methods; selection of study units; case study approach; data analysis tool and validity of the instruments and sources of errors for the study.

Chapter four analyses and discusses the empirical results. The quantitative results are presented as tables. Qualitative results are presented as descriptive narration, explaining why technicians and mechanics have some challenges in carrying out repair works.

Finally, in chapter five, the study findings are synthesized. The results are also elaborated on, and implications of the study are assessed recommended.

CHAPTER TWO

Literature Review

2.1 Introduction

In this chapter, we consider the parts of the vehicle and how the parts of the vehicle wear down. Most of these weary parts are very minimal that they are rarely seen. The writer will like to find out issues raised by other writers to enhance his urge for a comprehensive need of effective vehicular maintenance.

2.2 Engine

An engine is a machine designed to convert energy into useful mechanical motion. Heat engines, which includes internal combustion engines and external combustion engines burn fuel to create heat, which then creates motion Landels, (2009).A reciprocating engine, also often known as a piston engine, is a heat engine that uses one or more reciprocating pistons to convert pressure into a rotating motion (www.wikipedia.org).

2.3 Defects and Wear of Parts

In material science, wear is erosion or sideways displacement of material from its "derivative" and original position on a solid surface performed by the action of another surface. Wear is related to interactions between surfaces and more specifically the removal and deformation of material on a surface as a result of mechanical action of the opposite surface Williams, (2005).

The technical condition of automobile and its wear resistance depends on the design and production features and on the conditions of operation. The condition of parts and units changes in service owing to various defects and wear N-STEP, (2010).

The working life of an engineering component is expired when dimensional losses exceed the specified tolerance limits. Wear, along with other ageing processes such as fatigue and creep in association with stress concentration factors such as fracture toughness causes materials to progressively degrade, eventually leading to material failure at an advanced age.

Wear in industrial applications is one of a limited number of fault factors in which an object loses its usefulness and the economic implication can be of enormous value to the industry Chattopadhyay, (2001)

2.3.1 Types of Wear

According to Jones (1983), wear is divided into mechanical wear, abrasive wear, corrosive wear and fatigue wears.

i. **Mechanical Wear:** Mechanical wear stems from mutilation and chipping out of particles from surfaces. Mutilation of the surface changes the part size without altering its weight. Chipping changes both the weight and size of the parts.

ii. **Abrasive Wear:** This results from scratching or cutting action of harder particles of one of the mating parts, the particles entrapped with air or contained in the lubricant.

iii. **Corrosive Wear:** This is attributed to the action of corrosive media (acids, alkalis, oxygen) on the surface of parts.

iv. **Fatigue Wear:** This is caused by multiple alternating loads.

2.3.2 Causes of Wear

Most automobile parts are subjected to several types of wear simultaneously. The mating parts have definite clearances established during the design and manufacturing of mechanisms and units. As the parts wear, the clearances increase, the parts reach the limit of size at which they continue to operate normally and then additional loads impose excessive wear and disrupt normal functioning. The clearance grows progressively which may finally lead to failure or breakage of the parts and the ruining of the entire unit or mechanism.

2.4 Maintenance

The purpose of maintenance is to attempt to maximize the performance of equipment by ensuring that such equipment performs regularly and efficiently by minimizing losses resulting from breakdowns or failures. It is the objective of the maintenance function to maintain or increase the reliability of the Operating System as a whole (Lauren, 1996). According to Bahrm (1996), there are four types of maintenance practices.

i. Preventive Maintenance

ii. Reactive Maintenance

iii. Corrective Maintenance

iv. Predictive Maintenance

2.4.1. Preventive Maintenance

Preventive maintenance is a procedure utilizing programmed lubrication, servicing, external examination, and inspection. It also involves diagnosing faults, timely adjustments, repairs and replacement of defective parts by skilled technicians, preserving the equipment and minimizing maintenance cost thereby contributing to reduce breakdown. Preventive maintenance improves vehicle availability, reduces operational cost, increase unit life, prevents accident, pollution and thereby improves equipment reliabilityChase et. al, (1992). Preventive maintenance is an important factor which directly or indirectly influences the performance of machine which in turn, reflects the efficiency of an organization in terms of economy.

2.4.2 The Objective of Preventive Maintenance

The principal objectives of preventive maintenance programmes are to increase the:

- Efficiency of the equipment.
- Performance of the equipment.
- Productivity of complete unit.
- Certainty of meeting the target or completing job on specified time schedule.
- The other benefits of preventive maintenance are that it:

- Reduces running cost.
- Reduces the consumption of fuel and spare parts.
- Extends the useful period of equipment.
- Shows whether each unit is working economically or not.

2.4.3 Elements of Preventive Maintenance

According to Joseph Barrena (2012), the primary objective of preventive maintenance can be effectively achieved with the following elements:

- Routine external inspection of equipment.
- Periodic internal inspection of equipment and daily servicing.
- Diagnostic service to locate the faulty components.
- Replacing of faulty components immediately or before it spoils other parts.
- Daily routine adjustments and repairs.
- Enforcement of preventive maintenance, checking and inspection of components, sub-assemblies after schedule working hours.
- Service control, through record keeping.
- Record keeping for economic operation.
- Periodic analysis of system‟s operation parameter.
- Better supervision on maintenance and qualified maintenance technicians.
- Systematic work produces planning and scheduling.
- Training programme for maintenance technicians.
- Refresher courses to upgrade the knowledge of maintenance technicians for better upkeep of vehicles.

2.4.4 Reactive Maintenance

It can be defined as the maintenance which is required when an item has failed or worn out, and to bring it back to working order. Reactive maintenance is the most commonly used maintenance approach, but it is easy to see its limitations. When equipment fails, it often leads to downtime in production, and sometimes damages other parts. In most cases, it is an expensive maintenance strategy. Also, if the equipment needs to be replaced, the cost of replacing it alone can be substantial. Reliability of systems maintained by this type of maintenance is unknown and cannot be measured Johan, (2009).

2.4.5 Corrective Maintenance

Corrective maintenance is a maintenance task performed to identify, isolate, and rectify a fault so that the failed equipment, machine, or system can be restored to an operational condition within the tolerances or limits established for in-service operations Willmott, (1994).

2.4.6 Predictive Maintenance

The predictive maintenance strategy overcomes the drawbacks of reactive and preventive maintenance strategies by constantly monitoring actual equipment condition and using the information to predict when a problem is likely to occur. With that insight, one can schedule maintenance for the equipment that needs it, and only what needs it, before the problem affects process or equipment performance. That is a great way to improve maintenance productivity, as well as reduce costs for repairs and unexpected downtime www.plantweb.com, (2013).

2.4.7 Maintenance Schedules

The system of scheduled maintenance employed at motor transport pools is based on the preventive principle. All the operations included into each type of maintenance are obligatory and must be carried out in full. The maintenance system is aimed at keeping the vehicle in good working trim, reducing the wear of parts, cutting down the consumption of oil and fuel,

identifying and eliminating any defects in due time, thereby promoting the reliability and safety operation and extending the service life and run between overhauls of the vehicle Kia Service Manuals, (2011).

The inspection, diagnostic, fastening, lubricating, filling, adjusting, wiring and cleaning operations performed at times and in scopes specified the maintenance guides ensure normal operating conditions for all the system and mechanisms of the automobile.

Maintenance schedule is applicable to vehicles operating under normal operating conditions and vehicles operating under severe operations. In case, the operating conditions are severe, certain operations may have to be introduced based on experience. It has to be suitably modified for vehicles operating mostly in lower gears and all oil and fuel filters change should be advanced earlier than that mentioned where operating condition are arduous or dusty.

2.5 **Diagnosis**

As electronic control systems in vehicles become more advanced and sophisticated in the recent years, malfunctions have been increasingly more complicated. Automotive systems are safety-critical and are required to be highly fault-tolerant in operation. Automotive systems consist of mechanical, hydraulic, software and hardware components. There is a staggering amount of embedded computing within automotive systems. Software-intensive distributed electronic control systems are increasingly being used in the automobile industry to provide convenience and safety features to vehicle drivers and passengers, with increasing levels of automation and control authority. A growing trend is to assist the driver in maintaining safe control over the motion of the vehicle under a variety of conditions that include congested traffic conditions, adverse weather and road conditions, varying states of health of vehicle equipment, and varying skill levels of drivers. Previously such driver assistance has been provided in the form of information or warnings to the driver, but increasingly such assistance will be provided by actively manipulating actuators that control vehicle

longitudinal acceleration and deceleration, lateral position, and vertical displacement. The long term trend is towards partial or even fully autonomous operation of a single vehicle, or even of fleets of vehicles.

2.5.1 Vehicle Maintenance Facilities

Automobile shops should provide space and facilities for scheduled and unscheduled maintenance. This includes, but is not limited to, inspection, general repair and replacement of major assemblies, lubrication, fluid changes, tune-ups, tire rotation, painting, welding, upholstery repair, testing, cleaning, storage and retrieval of parts, and fabrication of minor parts. Provide support functions for maintenance control and analysis, tool room, parts room, locker rooms, and offices. Other elements of the facility includes a hazardous waste accumulation point, a dynamometer facility (certifies vehicle emissions), and various vehicle parking lots.

2.5.2 Service Manual

According to Nissan Service Manual (2010) service information manual consists of information necessary to maintain a product in good working order. This includes:

- Safety information
- Hydraulic fluid cleanliness requirements and recommendations
- Installation and start-up procedures
- Scheduled maintenance requirements
- Troubleshooting information
- Minor repair procedures

Minor repair procedures include repair and maintenance activities that can be performed on a product without violating the warranty. General maintenance contained in the service manuals includes those items which should be checked during the normal day-to-day operation of the vehicle. They are essential if the vehicle is to continue operating properly.

The owners can perform the checks and inspections themselves or they can have their dealers do them.(Nissan Service Manual, (2010).

2.5.3 General Maintenance

Maintenance list to be Performed on Outside the Vehicle

The maintenance items listed on table 2.1 should be performed from time to time, unless otherwise specifiedNissan Service Manual, (2010).

Table 2.1 **Maintenance *List to be Performed onOutside the Vehicle***

	Items
Lamps	Clean the head lamps on a regular basis. Make sure that the headlamps, stop lamps, tail lamps, turn signal lamps, and other lamps are all operating properly installed securely. Also check the aim of the headlamps.
Tires	Check the pressure with a gauge often and always prior to long distance trips. Adjust the pressure in all tires, including the spare, to the pressure specified. Check carefully for damage, cuts or excessive wear.
Wiper Blades	Check for cracks or wear if not functioning correctly.
Doors and Engine hood	Check that all doors and the engine hood operate smoothly as well as the back door, trunk lid and glass hatch. Also make sure that all latches lock securely. Lubricate if necessary. Make sure that the secondary latch keeps the hood from opening when the primary latch is released. When driving in areas using road salt or other corrosive materials, check lubrication frequently.
Tire rotation	Tires should be rotated every 10,000 km (6,000 miles) for 2WD models and every 5,000 km (3,000 miles) for 4WD models.
Windshield	Clean the windshield on a regular basis. Check the windshield at least every six months for cracks or other damage. Repair as necessary.

Maintenance List on Inside the Vehicle

The maintenance items listed here, on table 2.2 should be checked on a regular basis, such as when performing periodic maintenance, cleaning the vehicle, etc.

Table 2.2 **Maintenance List on Inside the Vehicle**

	Item
Accelerator pedal	Check the pedal for smooth operation and make sure that the pedal does not catch or require uneven effort. Keep the floor mats away from the pedal.
Brake pedal	Check the pedal for smooth operation and make sure that it has the proper distance under it when depressed fully. Check the brake booster function. Be sure to keep the floor mats away from the pedal.
Parking brake	Check that the lever or the pedal has the proper travel and make sure that the vehicle is held securely on a fairly steep hill when only the parking brake is applied.
Warning lamps and Chimes	Make sure that all warning lamps and chimes are operating properly.
Windshield defogger	Check that the air comes out of the defogger outlets properly and in good quantity when operating the heater or air conditioner.
Windshield wiper and washer	Check that the wipers and washer operate properly and that the wipers do not streak.
Steering wheel	Check that it has the specified play. Check for changes in the steering condition, such as excessive play, hard steering or strange noises.
Seat belts	Check that all parts of the seat belt system (e.g. buckles, anchors,

	adjusters and retractors) operate properly and smoothly, and are installed securely. Check the belt webbing for cuts, fraying, wear or damage.

Under the Hood and Vehicle check list

The maintenance items listed here in table 2.3 should be checked periodically (e.g. each time you check the engine oil or refuel.)

Table 2.3Under the Hood and Vehicle check list.

	Item
Windshield washer fluid	Check that there is adequate fluid in the tank.
Engine coolant level	Check the coolant level when the engine is cold.
Engine drive belts	Make sure that drive belts are not frayed, worn, cracked or oily.
Engine oil level	Check the level after parking the vehicle (on a level ground) and turning off the engine.
Brake fluid level	Make sure that the brake fluid level is between the “MAX” and “MIN” lines on the reservoir.
Battery	Check the fluid level in each cell. It should be between the “MAX” and “MIN” lines. Vehicles operated in high temperatures or under severe conditions require frequent checks of the battery fluid level.
Fluid leaks	Check under the vehicle for fuel, oil, water or other fluid leaks after the vehicle has been parked for a while. Water dripping from the air conditioner after use is normal. If you should notice any leaks or if

	gasoline fumes are evident, check for cause and have it corrected immediately.
Power steering fluid level and lines	Check the level when the fluid is cold, with the engine off. Check the lines for proper attachment, leaks, cracks, etc.

2.6 Periodic Maintenance

The following table 2.4 shows the normal maintenance schedule. Depending upon weather and atmospheric conditions, varying road surfaces, individual driving habits and vehicle usage, additional or more frequent maintenance may be required. Abbreviations: I = Inspect and correct or replace as necessary, R = Replace, E = Check and correct the engine coolant mixture ratio.

2.6.1 Maintenance under Severe Driving Conditions

The maintenance intervals shown on table 2.4 are for normal operating conditions. If the vehicle is mainly operated under severe driving conditions, more frequent maintenance is performed on the following items as shown in table 2.4. Under severe driving conditions, the following items must be considered:

A. Driving under dusty conditions
B. Driving repeatedly short distances
C. Towing a trailer or caravan
D. Extensive idling
E. Driving in extremely adverse weather conditions or in areas where ambient temperatures are either extremely low or extremely high
F. Driving in high humidity or mountainous areas
G. Driving in areas using salt or other corrosive areas

H. Driving on rough and/or muddy roads or in the desert

I. Driving with frequent use of braking or in mountainous areas

J. Frequent driving in water

Table 2.4 Maintenance under severe conditions check list

Driving condition	**Maintenance item**	**Maintenance Operation**	**Maintenance interval**
Severe	Engine oil & engine oil filter	Replace	Every 5,000 km (3,000 miles) or 3 months
Severe	Diesel fuel filter	Replace	Every 10,000 km (6,000 miles) or 6 months
Severe	Air cleaner element	Replace	More frequently
Severe	Brake fluid	Replace	Every 20,000 km (12,000 miles) or 12 months
Severe	Differential gear oil	Replace	Every 40,000 km (24,000 miles) or 24 months
Severe	Steering gear & linkage, axle & suspension parts, propeller shaft, & drive shafts	Inspect	Every 10,000 km (6,000 miles) or 6 months
Severe	Brake pads, rotors & other brake components	Inspect	Every 5,000 km (3,000 miles) or 3 months
Severe	Locks, hinges & hood latch	Lubricate	Every 5,000 km (3,000 miles) or 3 month
Severe	Air conditioner filter	Replace	More frequently
Severe	Drive belts	Inspect	Every 5,000 km (3,000

			miles) or 3 month
Severe	Engine coolant	Replace	Every 40,000 km (24,000 miles) or 24 months
Severe	Cooling system	Inspect	Every 5,000 km (3,000 miles) or 3 month
Severe	Fuel lines	Inspect	Every 5,000 km (3,000 miles) or 3 month
Severe	Spark plugs	Replace	Every 40,000 km (24,000 miles) or 24 months
Severe	Positive crankcase ventilation (PCV) System	Inspect	Every 10,000 km (6,000 miles) or 6 months
Severe	Wheel alignment (If necessary, rotate & balance wheels)	Inspect	Every 20,000 km (6,000 miles) or 6 months

2.6.2 Communication and Measuring Techniques

Vehicular Communication Systems are an emerging type of networks in which vehicles and roadside units are the communicating nodes; providing each other with information, such as safety warnings and traffic information. As a cooperative approach, vehicular communication systems can be more effective in avoiding accidents and traffic congestions than if each vehicle tries to solve these problems individually(http://en.wikipedia.org/wiki/Vehicular_communication_systems).

Providing safety is the primary objective of vehicular communication networks. Vehicles who discover an imminent danger such as an obstacle inform others. Electronic sensors in each car can detect abrupt changes in path or speed and send an appropriate message to

neighbours. Vehicles can notify close vehicles of the direction they are taking so the drivers can make better decisions; a more advanced version of turn signals. In more advanced systems, at intersections the system can decide which vehicle has the right to pass first and alert all the drivers. Some of the immediate applications are:

- Warnings on entering intersections
- Warnings on departing the highways
- Obstacle discovery
- Sudden halts warnings
- Reporting accidents
- Lane change warnings

2.6.3 Vehicle Control System (VCS)

The vehicle control system executes functions in the vehicle and controls all necessary conditions are fulfilled before doing so. To be able to do this several sensors and actuators are integrated in the system and connected to numerous vehicle control units (VCU) that handle the necessary computations. All communication is handled through a controller area network (CAN). The user interface is designed to be simple but robust and it is conducted through the multi-function panel (MFP).

2.6.4 Diagnostic Information System(DIS)

The diagnostic information system is a system that can be connected to a target system, with whichdifferent tasks are performed. The DIS software needs to be installed on the computer utilized for diagnostic and can perform several actions on the target system. Its main functions are divided into four areas that together complete the system:information flow, diagnostic tools, calibration and configuration. The information flow handles all data such as logs and signals and exports these from the target system to a designated external location. The diagnostics tools are used for analysis of the target system and helps in the fault isolation procedure. Calibration is mainly used to perform adjustments or calibrations of the target system but also gives the ability and enables to test some of the safety features within the target system. Configuration aids in the procedure when upgrading the target system software. It also gives information about the current software version within the target system.(Peter David 2002)

2.7 Automobile Service Business

According to Kryger and Kovacik (1986), the majority of automobile service business falls into one of the following categories:

- New-Car Dealerships
- Independent Garages
- Shops
- Service Stations
- Fleet Garages
- Auto supply and Accessory Stores, and Department stores.

2.7.1 New-car Dealership

Many automobile service functions are performed by dealerships. Dealer service departments usually coordinate all service activities. These activities may include preparing new and used automobiles for delivery to customers, servicing customer‟s automobiles and body repairs.Dealerships also serve as manufacturer‟s representatives in the performance of warranty repairs. A warranty repair or replacement of a defective part at the manufacture‟s cost. Another important function in some dealerships is the parts department. Spare part department keeps commonly used parts available for installation or replacement by the service department and for sale to the public. A well-managed parts department can be the most profitable section of a dealership.

2.7.2 Independent Garages

The independent garage is the primary source for automotive servicing in many communities. An independent garage typically offers customers a complete line of services. Maintenance services include oil and filter changes, chassis lubrication, tune up, brake repairs and electrical works, road wheels alignment and vulcanizing. Most independent garages also perform major and minor mechanical repairs. Some even overhaul engines and repair vehicle transmissions.

2.7.3 Specialty Shops

The automotive specialty shop usually concentrates on one type of automotive servicing or a limited number of services. The specialization allows the shop owner or manager to maintain close control of operations and expenditures. Examples of specialty shops are tyre maintenance, fuel injection system, and carburettor tune-ups and brake repairs facilities.

2.7.4 Service Stations

A service station is a fuel station that offers automotive servicing. One or more service bays, or work areas, may be used for maintenance and repair services. Some service stations perform only simple maintenance services, sell and install tyres and batteries. Others perform tune-ups, brake repairs and other maintenance services. Still other service stations may offer major repairs, such as overhauls.

2.7.5 Fleet Garages

Many businesses, government agencies and other organizations have fleets of automobiles. A fleet may consist of as few as two or three automobiles or it may number in the thousands. Small fleets are usually serviced by independent shops. Large fleets are often serviced in a garage owned by the organization that operates the fleet. Garages for major fleets usually have complete maintenance and repair capabilities.

2.7.6 Automobile Supply and Accessory Stores and Department Stores

Automobile supply and accessory stores frequently sell parts at reduced prices when installation is performed in their own service facilities. Many of these stores find it profitable to sell and install certain products.

2.7.7 The Need for Servicing and Maintenance

No part of an automobile is permanent, thus, the need for ongoing servicing. Routine service intervals have been extended on modern automobiles. However, regular scheduled maintenance is as important as ever. In addition, several factors contribute to the increasing need for trained and certified automobile mechanics. These factors are:

- More sophisticated automobiles
- Increased average age of automobiles
- Emissions and fuel economy requirements

2.8 Staff Development and Training

The workshop‟s success depends on all technicians understanding their jobs and having the ability and training to perform their jobs well. It is the Manager‟s responsibility to recruit qualified technicians, train and supervise them, and ensure that their performance is rewarded. While considerable “on-the-job” training usually occurs, formal training programs for new and experienced technicians will increase productivity in the workshop.

2.8.1 Utilization of On-the-Job (OJT) and Off-the-Job Training Systems (OFF JT)

The following descriptions are some key notes to activating OJT and Off JT processes.

- During the probation period, newly hired technicians are initially employed as apprentices. An experienced technician is assigned as a trainer.
- Under the trainer‟s guidance, an apprentice starts working on simple tasks while the trainer keeps records of their hours of work. The apprentice‟s salary, which must satisfy any statutory minimum wage for the country or region in question, will be paid according to the level of their skill and their hours of work.

It is recommend that this system be continued for six months to one year, not only for apprentices on probation, but also for technicians with little experienceNissan Service Management Textbook, (2010).

2.8.2 On-the-Job Trainer

- The trainer is responsible for training one or more technicians and for helping each technician improve their skills.
- The trainer spends time on training, but it is the trainee himself/herself who is responsible for the progress of their job.
- The trainer understands each technician‟s skill levels and training needs. He, together with the Manager, will establish a training plan.Nissan Service Management Textbook, (2010).

CHAPTER THREE

Methodology

3.1 Introduction

This chapter involved the research design, population of the study, sampling techniques and sample size, and data collection techniques like questionnaire, interview, and observation.

3.2 The Study Area

The study was carried out in various automotive vehicle workshops, and garages in Accra. The study area has been characterized and categorized into the various vehicle workshops, garages and service stations to interact with, and to observe for effective maintenance of vehicles.

The category of various automotive vehicle workshops visited for the study are the following independent garages: Divine motors at Circle in Accra,Senyofiting shop at Alajo, Amico Mechanical shop at AbekaLapaz in Accra, Goka automobile shop at Tessano, and Shitsi workshop at Osu in Accra. These garages were randomly chosen out of many in Accra based on the place of their location and their spread of deviation.

3.3 Research Design

The research design for this study was qualitativeThe advantage of qualitative data is that, the researcher does not fall in a trap of discussing issues to a greater depth, which may not provide a collective impression of the study population Bless, (2006)

3.4 Population of the Study

The target population for the study involved engineers, service managers, technicians, supervisors of workshops, mechanics in garages and drivers in Accra.

3.5 Sampling Techniques and Sample Size

Random sampling method was employed. The individual sample involved in the study areas was fifty-five (55). These including twenty (20) mechanics, fifteen (15) technicians, five (5) service engineers, five (5) independent garage managers, and ten (10) drivers. In a simple random sample of a given size, all such subsets of the frame are given an equal probability.

Each element of the frame thus has an equal probability of selection: the frame is not subdivided or partitioned. Furthermore, any given pair of elements has the same chance of selection as any other such pair (and similarly for triples, and so on). This minimises bias and simplifies analysis of results. In particular, the variance between individual results within the sample is a good indicator of variance in the overall population, which makes it relatively easy to estimate the accuracy of results. Five (5) independent garages and various workshops were respectively chosen randomly in Accra for the study.

3.6 Data Collection Techniques

The data collection techniques used are, structured questionnaires, interviews and observation techniques were used to gather primary data for the project.

3.6.1Questionnaire

Questionnaire were developed and distributed to the engineers, technicians, including service managers, workshop supervisors, workshop foremen, mechanics, artisans, all in the various garages in Accra, and drivers in Accra. The issues in the questionnaire involved the following:

- Bio data
- Inspection procedures
- The skills of performing effective and efficient maintenance and repair work
- The designing of effective and efficient maintenance services and record retention
- Genuine parts and materials used for effective and efficient maintenance and repair work
- Supervision for quality control
- Scheduled maintenance service

3.6.2 Interview

Five independent garage owners were interviewed in Accra. Interviewwas used to find out the magnitude of reliable maintenance of vehicle in these garages.

The issues involved in the interviews are:

- Maintenance procedures based on the service manual.
- Maintenance schedules for vehicles, diagnostic equipment used for diagnosing and repair works, genuine spare parts identification from the fake once.
- Quality control on maintenance and repair work.

Respondents were interviewed using semi-structured interview and their responses, were noted down.

3.6.3 Observation: The researcher visited fiveindependent garages in Accra to find out how successfully maintenance is carried out to prevent vehicular accident on our roads.

The independent garages visited were: Divine motors at Circle in Accra, Senyofiting shop at Alajo in Accra, Amico Mechanical shop at AbekaLapaz in Accra, Goka automobile shop at Tessano in Accra, and Shitsi workshop at Osu in Accra. The researcher also visited vehicle dealership workshop and garages, which includes Japan Motors in Accra, Toyota Company in Accra to observe how the mechanics and technicians carry out maintenance and repair work on vehicles.

An observation chart was designed to observe various maintenance schedules for vehicles, procedure for effective and efficient maintenance and servicing of vehicles in various workshops and garages.The Check List on the observation chart used as guide, includes lights, horn, brake/clutch pedal travel, meters and gauges, headlight aim, fluid levels, drive belt, hoses and pipes, brake wear and leak.This observation was done to have the first hand information on the effective and efficient maintenance and servicing based on the questionnaire and interviews conducted. All the five independent garages were visited two times each

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents data obtained from the questionnaires, interviews, and observations.

4.2 Results of Questionnaires.

The questionnaires were obtained from independent automotive garage mechanics, technicians from well-established automobile service workshops, service engineers, and drivers who handle the vehicles.

4.2.1 Results of Questionnaire from garage Mechanics

The profile of the respondents indicated their highest level of education as shown in table 4.1. The categories considered were None, Primary, JSS/MSLC, SSS/MVM, and others respectively for mechanics.The results showed that, eleven mechanics,representing55% of the respondents had JSS/MSLC level of education, whilst four mechanics representing20% had Secondary/Technical education. Mechanics with no educational background were three representing 15% of the total Respondents.

Table 4.1 Education Level of mechanics

Category	Mechanics	Percentage (%)
None	3	15
Primary	2	10
JSS/MSLC	11	55
SSS/MVM	4	20
Others	0	0
Total	20	100

The focus group discussion revealed that education had a positive impact on automotive repair service. This is because respondents with higher education understand better the procedures on repairs and maintenance procedure and technique in service manuals.

Training Institution *of mechanics*

These were intended to find out whether the respondents had their apprenticeship in a recognized institution. The training centres considered were wayside, dealership, vocational school, technical school and polytechnic. The training institution has a direct bearing on the calibre of mechanics they produce. The study revealed that, majority of the mechanics made up of fourteen representing, 70% were trained at Wayside garages, whilst three mechanics representing 15%, of the respondents were trained by Dealerships. Also, two mechanics representing10%, had their training at vocational institution, and one mechanic attended technical School representing 5%, of the respondents, as shown in table 4.2.

Table 4.2 Training Institution attended by mechanics

Category	**Mechanics**	
Training Institution	**Response**	**Percentage %**
Wayside Garage	14	70
Dealership	3	15
Vocational Institute	2	10
Technical School	1	5
Polytechnic	0	0
Total	20	100

Training Period of Mechanics

Table 4.3 presents the responses of the mechanics training periods of the respondents under consideration. The study revealed that only one mechanic representing 5% of the respondents, had one year apprenticeship.Whilstapprenticeship for 4years, and 5years, and more recorded two mechanics each representing10% respectively. Seventeen mechanics representing 85% of the respondents spent between 2-4 years in the training institution.

Table 4.3 Apprenticeship Period*for mechanics*

Apprenticeship	Response	Percentage %
1yr	1	5
2yrs	6	30
3yrs	9	45
4yrs	2	10
5yrs and more	2	10
Total	20	100

Working Experience*of mechanics*

The experiences of the respondents, under consideration were captured. In the category of 1 – 5 years, the mechanics were four representing 20% of the respondents, as shown in table 4.4. The study revealed that majority of the respondents that is eleven mechanics had a working experience of between 5-10 years, while none of the respondents worked for less than 1 year. It also showed that only one mechanic representing 5% had a working experience of above 20 years.

Table 4.4 Post-training experience gained by *mechanics*

Category	Mechanics

Experience	Response	Percentage%
Below 1	0	0
1 – 5yrs	4	20
5 – 10yrs	11	55
10 – 15yrs	2	10
15 - 20yrs	2	10
Above 20yrs	1	5
Total	20	100

Customers

Customers play a decisive role in determining the survival of any business. The question on loyal customers was used to determine which groups of customers patronize the services of mechanics as shown in table 4.5. The respondents, fifteen mechanics representing 75% repaired and maintained vehicles for individuals, while threemechanics representing 15%, repairedand maintained Government Agencies vehicleand two mechanics representing 10% of the respondents repaired for corporate bodies. These results suggest that most of the wayside garages and dealerships had their customer bases.

Table 4.5 Customers

Category	Mechanics	
Customers	**Response**	**Percentage%**
Individuals	15	75
Corporate	2	10
Gov. Agencies	3	15
Total	20	100

Maintenance Type practiced

The study attempted to understand whether the respondents carried out either distance or time based maintenance as captured in table 4.6. The study showed that seventeen mechanics representing 85% of therespondents practiced time based maintenance.Whilstthree mechanics, representing, 15% of the respondents, carry out distance based maintenance. In the service manual,these findings are compatible with the general impression by most vehicle users that wayside mechanics do not understand maintenance procedures and time intervals for carrying out maintenance practices.

Table 4.6 Maintenance TypePracticed

Category	Mechanics	
Maintenance Type	**Response**	**Percentage%**
Time Based	17	85
Distance Based	3	15
Total	20	100

Spare Parts Assessment

In table 4.7 interesting results were noted after cross tabulating responses to question on how the respondents assessed the condition of the vehicle parts before replacement as contained in the survey. The categories of assessment considered were visual inspection and testing of parts. Twentymechanics representing100% of respondents, assessed parts by visual inspection. The results reveal that all the mechanics performed visual inspection prior to spare parts replacement, but not testing the spare parts. From a logical point of view, the mechanics could be changing spare parts that are not damaged as they only performed visual inspection

Table 4.7Spare Parts Assessment

Category	**Mechanics**	
Parts' Assessment	**Response**	**Percentage%**
Visual Inspection	20	100
Testing	0	0
Total	20	100

Supervision

Thesupervision in the survey was intended to reveal whether the supervisors guide the respondents whenever they are carrying out repair and maintenance works. Table 4.8 showed how the respondents responded to this question. According to the survey, majority of the mechanics(sixteen mechanics representing 80%of the respondents)stated that they were sometimes supervised, very often and often as depicted. A total of four mechanics representing 20% of respondents were supervised all the time as part of the quality control and quality assurance measures in order to minimise the rate of return jobs. The focus group discussion also revealed that most of the supervisors are always busy and had no time to

supervise mechanics under their supervision. In the discussions, there was consensus that most accident that happened could have been caused by poor workmanship especially by these wayside mechanics.

Table 4.8 Supervision

Category	Mechanics	
Supervision	**Response**	**Percentage%**
All of the time	1	5
Very often	1	5
Often	2	10
Sometimes	16	80
Hardly ever	0	0
Total	20	100

Use of Service Manual

The study investigated whether the respondents used service manuals during repair works on vehicles, an important element of good quality work. The result shown in table 4.9 indicated that, all the twenty mechanics representing 100% of the respondents never used service manuals during maintenance process.

Table 4.9 Service Manual

Category	Mechanics	
Service Manual	**Response**	**Percentage%**
Not at all	20	100
Very often	0	0
Often	0	0
Others	0	0
Total	20	100

Spare Parts Acquisition

The spare parts acquisition was intended to collect information about how the mechanics obtained the spare parts for their repair works. This is because the parts acquisition for maintenance and repair works is at the heart of service operation at the dealership. Table 4.10 illustrates that, three mechanics representing15% of respondents had their spare parts from automobile dealerships, while seventeen mechanics representing 85% had their supply from the local market. This is quite a substantial percentage considering that most of the spare parts from the local market are either used spare parts or fake spare parts. If they are new spare part there is no trade mark on them, although some of them may have different identification number, and a logo.

Table 4.10 Spare Parts Acquisition

Category	Mechanics	
Spare Parts	**Response**	**Percentage%**
Dealers	3	15
Local Market	17	85
Total	20	100

Types of Spare Parts used in repair works

Table 4.11 presents the responses of the mechanics on what typeof spare parts they used in their maintenance and repair works. The categories considered were genuine, fake spare parts and used spare parts. It showed that only three mechanics representing15% of the respondents used genuine spare parts. Also eleven mechanics representing55%of respondents maintained vehicles with used spare parts, while six mechanics representing 30% of the respondents used non genuinespare parts. On average, most mechanics considered non genuine spare parts and used spare parts for their maintenance works. These findings are in agreement with other results pertaining to spare parts acquisition. For instance, most mechanics considered buying spare parts from the local market.

Table 4.11 Types of Spare Parts Used in Repair Works

Category	Mechanics	
Spare Parts Type	**Response**	**Percentage%**
Genuine Spare Parts	3	15
Non Genuine Spare Parts	6	30
Used Spare Parts	11	55
Total	20	100

Diagnostic Equipment Training

The diagnostic equipment training was intended to find out from the respondents whether they were trained on how to use diagnostic equipment. The use of diagnostic tools and equipment play an important role in the quality of repair work. Table 4.12 indicated that, only six mechanics representing30%, had training in handling diagnostic equipment. The remaining fourteen mechanics representing 70% of the respondents had no training on the use of diagnostic tools. The study explored the respondents‟ knowledge on the type of diagnostic equipment used in their garages and to state the type of diagnostic tools they were trained on.

Table 4.12 Diagnostic Equipment Training for mechanics

Category	**Mechanics**	
Diagnostic Equipment	**Response**	**Percentage%**
Diagnostic Training	6	30
No Diagnostic Training	14	70
Total	20	100

Vehicle Diagnosis

As shown in table 4.13, the respondents were asked to state whether they were trained on how to perform vehicle diagnosis with diagnostic equipment. Vehicle diagnosis is a very important element in vehicle repairs. The majority of theeighteen mechanics representing 90% had no training on how to perform vehicle diagnosis, while only twomechanics representing 10% had training on how to perform vehicle diagnosis.

Table 4.13 Vehicle Diagnosis

Category	Mechanics	
Vehicle Diagnosis	**Response**	**Percentage%**
Trained on Diagnosis	2	10
No Training on Diagnosis	18	90
Total	20	100

Repairs on Electronic Systems

On electronic system, it was intended to know whether the mechanics could repair and service vehicles with highly sophisticated electronic systems. The table 4.14 shows how the mechanics responded. It showed that only one mechanics representing5% of the respondents felt confidently that he can repair and service vehicles with sophisticated electronic systems, while the remaining nineteen mechanics representing 95% of respondents were uncertain on electronics vehicle repairs. In summary, the findings suggest that majority of the respondents cannot keep pace with latest technological advancement in the automobile sector and therefore cannot confidently repair and work on vehicles with electronic systems.

Table 4.14 Repairs on Electronic Systems

Category	Mechanics	
Electronic Systems	**Response**	**Percentage%**
Yes	1	5
No	19	95
Total	20	100

4.2.2 Results of Questionnaire from Technicians

The technicians were asked to indicate their highest level of education as shown in table 4.15. The categories considered were, SSS/MVM, Technician, Diploma, Bachelor Degree, Master Degree. The results showed that elevenmechanics representing 73.33% of respondents had Diploma qualification, three mechanics representing20% attended SSS/MVM and one mechanics representing 6.67% had Bachelor degree.

Table 4.15 Educational Level for Technicians

Category	Number of technicians	Percentage (%)
SSS/MVM	3	20
Diploma	11	73.33
Bachelor Degree	1	6.67
Total	15	100

Training Institution

Thetraining institution attended by the technicians where they had their apprenticeship in a recognized institution. The trainingcentres considered was wayside, dealership, vocational school, technical school and polytechnic. The training institution had a direct bearing on the calibre of techniciansthey produce. The study revealed that nine technicians representing 60% were trained by garage dealership, whilst two technicians representing13.33 % were trained in Technical Schools, and in Polytechnic, and in Vocational Schools, asshowed in table 4.16.No Technician was trained by wayside garages or independent.

Table 4.16 Training centres for Technicians

Category	Technicians	Percentage%
Wayside Garage	0	0
Dealership	9	60
Vocational Institution	2	13.33
Technical School	2	13.33
Polytechnic	2	13.33
Total	15	100

Working Experience of technicians

The working experiences of technicians under consideration were captured. In the category of 1 – 5 years,seven technicians representing 46.67% of respondents had that experience. Five technicians representing 33.33%, works between5 – 10years and two technicians representing 13.33% of the respondents had between 10 – 15 years, as shown in table 4.17. The study revealed that majority of the respondents had a working experience of between 1-5 years, which is while none of the respondents worked for less than 1 year. The table reveal that no technicians have worked for more than 20years.

Table 4.17 WorkingExperience of technicians

Category	**Technicians**	
Experience	Response	Percentage%
Below 1	0	0
1 – 5yrs	7	46.67
5 – 10yrs	5	33.33
10 – 15yrs	1	6.67
15 - 20yrs	2	13.33
Above 20yrs	0	0
Total	15	100

Customers

Customers play a decisive role in determining the survival of any business. Theloyal customers wereused to determine which groups of customers patronize the services of technicians as shown in table 4.18. It showed that technicians work mostly for corporate organisations.Seven technicians representing46.67%work for corporate bodies,whilst six technicians representing40% of respondents work for government agencies. Only two

technicians representing13.33% works in individual garages.This showed that most technicians do not work in individual garages, due to perceived high charges by the dealerships. These results suggest that most of the wayside garages and dealerships had their customer bases.

Table 4.18 Customers

Category	Technicians	
Customers	**Response**	**Percentage %**
Individuals Garages	2	13.33
Corporate	7	46.67
Gov. Agencies	6	40
Total	15	100

Types of Maintenance carried out

In table 4.19 the study attempted to understand whether the respondents carried out either distance based maintenance or time based maintenance as captured. The study showed that two technicians representing13.33% of the respondents practiced time based maintenance, while thirteen technicians representing86.67% of the technicians practiced distance based maintenance as outline in the service manual. These findings are compatible with the general impression by most vehicle users that technician‟s understood maintenance procedures and intervals for carrying out maintenance practices.

Table 4.19 Types of Maintenance carried out

Category	Technicians	
Maintenance Type	**Response**	**Percentage%**
Time Based	2	13.33
Distance Based	13	86.67
Total	15	100

Spare Parts Assessment

In table 4.20, interesting results were noted after cross tabulating responses on how the respondents assessed the condition of the vehicle parts before replacement. The categories of assessment considered were visual inspection and testing. The results reveal that all the mechanics performed visual inspection prior to spare parts replacement. On the other hand, technicians performed both visual inspection and testing.Six technicians representing 40% of the respondents used visual inspection for spare parts assessment, whilst nine technicians representing 60% of respondents used testing assessment the parts to be replaced. From a logical point of view, the mechanics could be changing spare parts that are not damaged as they only performed visual inspection.

Table 4.20 Spare Parts Assessment

Category	Technicians	
Parts' Assessment	**Response**	**Percentage%**
Visual Inspection	6	40
Testing	9	60
Total	15	100

Supervision

Thesupervision was intended to reveal whether the supervisors guide the respondents whenever they are carrying out repair and maintenance works. The table 4.21 indicated how the respondents responded to supervision of work. According to the responses, majority of the twelve technicians representing 86.67%of the respondents stated that they were supervised all the time, very often and often as depicted in the table. A total of five technicians representing 33.33% of the respondents were supervised all the time as part of the quality control and quality assurance measures in order to minimise the rate of return jobs. The focus group also revealed that most of the supervisors are always busy and have no time to supervise mechanics under their supervision. In the discussions, there was consensus that most accident that happened could have been caused by poor workmanship especially by these wayside mechanics.

Table 4.21frequency ofSupervision

Category	**Technicians**	
Supervision	**Response**	**Percentage%**
All of the time	5	33.33
Very often	7	46.67
Often	1	6.67
Sometimes	2	13.33
Hardly ever	0	0
Total	15	100

Use of Service Manual

The study investigated whether the respondents used service manuals during repair works on vehicles, an important element of good quality work. The result showed in table 4.22 indicated the use of service manual during maintenance process.Twelve technicians representing 80% of the respondents used service manuals all the time. The remaining three technicians representing 20% of the respondents do not use service manuals.

Table 4.22 Use of Service Manual

Category	**Technicians**	
Service Manual	**Response**	**Percentage%**
Not at all	3	20
Very often	12	80
Often	0	0
Others	0	0
Total	15	100

Sources of Spare Parts Acquisition

Table 4.23 On spare parts acquisition,it was intended to collect information about how technicians obtained the spare parts for their repair works. This is because the parts acquisition for maintenance and repair works is at the heart of service operation at the dealership. It was noted that fourteen technicians representing93.33% of therespondents had their spare parts from automobile dealerships, while one technicians representing,6.67% had their supply from the local market.

Table 4.23 Sources of Spare Parts Acquisition

Category	Technicians	
Spare Parts	**Response**	**Percentage%**
Dealers	14	93.33
Local Market	1	6.67
Total	15	100

Useof GenuineSpare Parts

The table 4.24 showed that all the technicians used genuine spare parts. These findings are in agreement with other results pertaining to spare parts acquisition. For instance, most mechanics considered buying spare parts from the local market. The technicians were further asked to state how they would differentiate between genuine spare parts and non genuine spare parts, the result showed that the main difference in identifying genuine parts is by the source, part number and visual inspection. This is because all the parts from authorized dealerships are always from original equipment manufacturers.

Table 4.24 Used of Genuine Spare Parts

Category	Technicians	
Spare Parts Type	**Response**	**Percentage %**
Genuine Spare Parts	15	100
Non Genuine Spare Parts	0	0
Used Spare Parts	0	0
Total	15	100

Diagnostic Equipment Training for technicians

The diagnostic equipment training was intended to find out from the respondents whether they were trained on how to use diagnostic equipment. The use of diagnostic tools and equipment play an important role in the quality of repair work. Table 4.25 indicated that all the technicians had training on the use of diagnostic equipmentthat is fifteen technicians representing 100%. The study explored the respondents‟ knowledge on the type of diagnostic equipment used in their garages and to state the type of diagnostic tools they were trained on. The result showed they were trained on Universal Diagnostic Tools, OBD II Scanners, Cooling System Tester, Multimeter and Compression Tester.

Table 4.25 Diagnostic Equipment Training for Technicians

Category	**Technicians**	
Diagnostic Equipment	**Response**	**Percentage %**
Training on Diagnostic Equipment	15	100
NoTraining on Diagnostic Equipment	0	0
Total	15	100

Vehicle Diagnosis by Technicians

As shown in table 4.26, the respondents were asked to state whether they were trained on how to perform vehicle diagnosis. Vehicle diagnosis is a very important element in vehicle maintenance and repair works. The majority of thethirteen technicians representing 86.67% had training on how to perform vehicle diagnosis; while two technicians representing 13.33% had no training.

Table 4.26 Vehicle Diagnosis by Technicians

Category	Technicians	
Vehicle Diagnosis	**Response**	**Percentage %**
Training on Vehicle Diagnosis	13	86.67
No Training on Vehicle Diagnosis	2	13.33
Total	15	100

Types of Vehicle works on by Technicians

Table 4.27represented the responses of the technicians to the question – which of the following vehicles do you usually work on. The categories of vehicles considered were Saloon, Cross country, Pick-ups, Light duty trucks, and heavy duty trucks. The results showed that six technicians representing 40% of the respondents worked on saloon cars, while two technicians representing 13.33% worked on cross country vehicles. However, none of the respondents ever worked on heavy duty trucks. The result also showed that Pick-ups and light duty vehicles each recorded two technicians representing13.33% respectively of the respondents.

Table 4.27 Types of Vehicle works on*by *technicians

Category	Technicians	
Vehicle Type	**Response**	**Percentage %**
Saloon	6	40
Cross Country	2	13.33
Pick-ups	5	33.33
Light Duty Trucks	2	13.33
Total	15	100

Maintenance Plan for Technicians

The study attempted to understand what maintenance strategy is practiced at the dealership by the technicians under study, as ascertained under the question on what maintenance plan the respondents carry out. Table 4.28 indicated the three maintenance strategies: preventive, breakdown/reactive and predictive. The result showed that respondents mostly practiced preventive maintenance as it accounted for six technicians representing60% of the respondents, while breakdown recorded five technicians representing40% of the respondents. None of the respondents practiced predictive maintenance strategy,

Table 4.28 Maintenance Plan for Technicians

Category	**Technicians**	
Maintenance Plan	**Response**	**Percentage%**
Preventive	9	60
Breakdown	6	40
Predictive	0	0
Total	15	100

Training on Service Manual

As shown in table 4.28, respondents were asked to state whether they have had technical training on how to use maintenance procedures outline in the service manuals. Training on the use of service manual plays an important role in ensuring that diagnostics are done quickly and accurately, hence good quality work is achieved. The result showed that majority of the respondents, twelve technicians representing 80%of respondents had knowledge on how to use maintenance procedures in the service manuals, while three technicians representing 20% said they had no technical training in using service manual.

Table 4.29 Uses of Service Manual by Technicians

Category	Technicians	
Service Manual	**Response**	**Percentage %**
Uses of Service Manual	12	80
Does not Used Services Manual	3	20
Total	15	100

Uses of Service Manual by Technicians

The study also investigated whether the respondents used service manuals during repair works on vehicles, an important element of good quality work. The result showed that, all the respondents used service manual during maintenance.

Onboard Diagnostic (OBD) Repairs by Technicians

Table 4.29 presented the responses on how successful do technicians solve or repair problems on Onboard Diagnostics (OBD) vehicle. The categories considered were very successful, successful, challenging and others. The results showed one technician representing 6.67% of the respondents were very successful in repairing vehicles with onboard diagnostic problems, while six technicians representing 40% of the respondents were also successful. The study revealed that majority of the respondents; eight technicians representing 53.33% of the respondent had challenges in repairing these vehicles. In total, seven technicians representing 46.67% of the respondents can confidently and successfully repair vehicles with OBD problems.

Table 4.29 OBD Repairsby Technicians by Technicians

Category	Technicians	
OBD Repairs	**Response**	**Percentage %**

Very Successful	1	6.67
Successful	6	40
Challenging	8	53.33
Others	0	0
Total	15	100

Table 4.30 OBD Faults Challenges

Category	**Technicians**	
OBD Fault	**Response**	**Percentage %**
Ignition/ElectronicsFault	10	66.67
FuelFault	5	33.33
CoolingFault	0	0
Other Faults	0	0
Total	15	100

OBD Faults Challenges

The study further attempted to understand some of the challenges that the technicians encounter in repairing vehicles with OBD problems. The results as shown in table 4.30indicated that ten technicians representing 66.67% of the respondents had challenges in repairing ignition and electronic problems on the engine, whilst five technicians representing 33.33% of the respondents, had difficult in diagnosingOBD fuel systemfaults. With regards to common faults that the technicians often encountered, they stated the following: vehicle hesitationfault, engine stallingfault, and lackof power, difficult starting and high fuel consumption as their challenges in maintenance and repair work of the vehicle.

4.2.3 Results of Questionnaire from Service Engineer

As shown in table 4.31, the service engineers were asked to state whether they have technical training programmes for their technicians. The result showed that all the respondents had technical training for their technicians.

Table 4.31 Technical Training Programme Organised by Service Engineer

Category	**Service Engineers**	
Technical Training	**Response**	**Percentage%**
Technical Training Programme	5	100
No Technical Training Programme	0	0
Total	5	100

The study further requested the respondents to state the scope of the training programme. The study revealed that the technicians were trained on engine maintenance and repairs, chassis, electrical and electronics systems, new models and diagnostic training at all levels. These showed that technicians at dealerships are well equipped to work on vehicles with sophisticated systems.

Evaluation of Technicians by Service Engineer

The evaluation tried to elicit responses from the service engineers on how often they evaluated the performance of their technicians. The results shown in table 4.32 indicate that the majority of service engineers offourrepresenting80% of respondents often evaluated their

technicians, while one engineer representing20% ofrespondents stated that they sometimes evaluated them.

Table 4.32 Evaluation of Technicians by Service Engineer

Category	**Service Engineers**	
Evaluation	**Response**	**Percentage%**
Never	0	0
Rarely	0	0
Sometimes	1	20
Often	4	80
Total	5	100

Qualified Technicians having Effect on Service Engineer

Table 4.33 shows responses to shortages of qualified technicians in the dealership workshopthat had effect on their services. The result showed that four engineers representing 80%of respondents disagreed that they did not experience shortages of qualified technicians. While one engineer representing 20% of the respondents strongly agreed that there were shortages of qualified technicians,of the respondents.

Table 4.33 ***Qualified Technicians*** **having Effect on Service Engineer**

Category	**Service Engineers**	
Qualified Technicians	**Response**	**Percentage%**
Technicians	4	80
Shortage of technicians	1	20
Total	5	100

A serious shortage of available qualified technicians could result in delay in completing repair jobs and cause low quality issues. The major challenge in the automobile industry is the creation of highly skilled human resource required for the industry.

Tools and Equipment for Repair Work in the Garage

Survey on tools and equipment was intended to collect information about whether the dealerships under the study had the requisite tools and equipment for their maintenance and repair works. Lack of appropriate tools and equipment could affect technicians in carrying out proper diagnosis on the vehicle. This is due to the fact that technological advancement has brought several changes and modifications in automobile systems. Within this contest it is noted that an important issue of workforce development and equipment are needed to ensure that resources are developed to such an extent that the achievement of desired rate of technological changes will not be impeded through lack of personnel with suitable skills and equipment. The study revealed that four engineers representing 80% of the respondents agreed that their workshops had all the requisite tools and equipment, while the remaining one engineer representing 20% strongly agreed that there was not enough tools and equipment in his workshops as indicated in table 4.34

Table 4.34 Tools and Equipment for Repair Work in Garages

Category	Service Engineers	
Tools and Equipment	**Response**	**Percentage%**
Availability of Tools in the workshop	4	80
Not enough Tools	1	20
Total	5	100

Use of Parts*of Fake Spare Parts*

Table 4.35 displays the frequencies and percentages of responses to the use of fake spare parts. The question was aimed at establishing the degree to which the customers can be assured of quality spare parts from the dealers.

Table 4.35 Use of Fake Spare Parts

Category	Service Engineers	
Used of Spare Parts	**Response**	**Percentage%**
Genuine spare parts	5	100
Fake Spare Parts	0	0
Total	5	100

The table 4.35 indicated thatfive engineers representing 100% of the respondents strongly disagreed that fake spare parts were used during maintenance operation; this showed that all the respondents, 100% disagreed that fake spare parts were used by the dealerships. Generally, the table suggests that all the dealerships used genuine parts from original equipment manufacturers for their repair works.

Record Keeping on Vehicle

The respondents wereto find out whether the dealerships have any structured record keeping system informing them of the fault history of a customer‟s vehicle. Table 4.36 shows frequencies and percentages of the responses. It was found that, engineers representing 100% of the respondentsagreed that, records of repair history on all vehicle are available, indicating that all dealership customers‟ vehicle hassystem for keeping vehicle fault history

Table 4.36 Repair History on Fault Vehicle

Category	**Service Engineers**	
Repair History	**Response**	**Percentage%**
Records available	5	100
No records available	0	0
Total	5	100

Service Manual Procedures

The study also investigated whether the respondents used service manuals during repair works on vehicles, an important element of good quality work. The result showed in table 4.37 indicating one engineer representing 20% of the respondents said that, it is very true that technicians don‟t follow procedures outline in the service manual, while two engineers representing 40% of the respondents said, it is used sometimes. The remaining two engineers representing 40% of the respondents also stated that technicians do not use service manual.

Table 4.37 Service Manual Procedures

Category	Service Engineers	
Service Manual Procedures	**Response**	**Percentage%**
Used Very Often	1	20
Used Sometimes	2	40
Not used	2	40
Total	5	100

Technical Meetingsorganised by Service Engineer

The technical meetings wereanticipated to collect information and pass on information to the workers. Itis also organised to discuss issues relating to the critical andqualityrepair works at the dealerships under consideration. The categories considered were very often, sometimes, rarely, not at all. As shown in table 4.38one engineer representing 20% of the respondents indicated no technical meetings was organised. Two engineers representing 40% of respondents rarely organised technical meetings for their staff, while two engineers representing 40% of the respondents sometimes organised technical meetings. The study also revealed that all of the respondents did not see the need for regular technical meetings. This could contribute to the poor quality of work on the part of most technicians in the automotive dealerships industries.

***Table 4.38 Technical Meetings* organised by Service Engineer**

Category	**Service Engineers**	
Technical Meetings	**Response**	**Percentage%**
Very often	0	0
Sometimes	2	40
Rarely	2	40
Not at all	1	20
Total	5	100

Staff Suggestions to Engineers

Staff suggestion can be a productive workplace initiative, helping staff feel valued and engaged. Businesses thrive on good ideas and can help shape everything from the way an organisation operates to its next range of services. And, because there are no rules over who will come up with a way to revolutionize a business, one could be missing a trick if companies are not capturing employees‟ ideas through a staff suggestion scheme. The respondents were asked to state whether the workshop manager seriously considered staff suggestions for improving the quality of repair jobs in the workshop. The table 4.39 showed that four engineer representing 80% of the respondents agreed that staff suggestions were considered, while one engineer representing 20% disagreed that staff suggestions were considered for improving the quality of repair works in the workshop, as indicated in table 4.39.

Table 4.39 ***Staff Suggestions to Engineer***

Category	**Service Engineers**	
Staff Suggestions	**Response**	**Percentage%**
Agree on improving the quality of repaired job	4	80
Disagree on improving the quality of repaired job	1	20
Total	5	100

Incentives Scheme by Engineers

All the respondents claimed that their technicians were always rewarded for exceptional work done as indicated in table 4.40. That is five engineers representing 100% of the respondents. This incentive schemes are designed to encourage commitment to increasing productivity or in achieving some worthwhile objective such as improving the quality of repair work in the workshops. The study showed that,all the respondents agreed that a bonus scheme is in place where technicians are rewarded for exceeding their monthly target in terms of the number of jobcompleted or at the end of the year. Further study revealed that each technician is given a percentage of the total labour generated either at the end of the month or the year.

Table 4.40 **Incentives Scheme by Engineers**

Category	**Service Engineers**	
Rewards	**Response**	**Percentage%**
Agree to encourage commitment to work	5	100
Disagree to encourage commitment to work	0	0
Total	5	100

Shortcuts of Repairing Vehicle

All the responses byfive engineers representing 100%of the respondents disagreed that shortcuts were taken whenever pressure is built up in the workshop. This is illustrated in table 4.41, which shows whether the workshop manager wants the technicians to work faster even if it is a means of taking shortcut in completing the jobs. In total, all the respondents disagreed that shortcuts were taken to complete repair jobs whenever customers wanted their vehicles on promised delivery time.

Table 4.41 Shortcuts of Repairing Vehicle

Category	**Service Engineers**	
Shortcuts	**Response**	**Percentage%**
Agreein completing repair jobs	0	0
Disagreein completing repair jobs	5	100
Total	5	100

Speak Freely on Maintenance Problem

The free expression was intended to reveal whether respondents allowed technicians, and mechanics to speak freely if they see something that may negatively affect the quality of the repair works. The categories considered were always, sometimes, and never. The result showed that majority of the respondents, three engineers representing60% of the respondents sometimes commented on practices that could negatively affect the quality of repaired works, while two engineers representing 40% of the respondents speak most of the timereferred to Table 4.42.

Table 4.42 Speaking Freely in the Workshop

Category	Service Engineers	
Speak Freely	**Response**	**Percentage%**
Always	2	40
Sometimes	3	60
Never	0	0
Total	5	100

Service Engineer's Satisfaction on Repair Work

The satisfaction on repair work was intended to reveal whether the respondents were satisfied with the standard of repair works in their various workshops. To be satisfied with the quality of repair service indicates a measure of satisfaction with the dealerships. Table 4.43 shows how the respondents responded to this question. The result showed that allthe five engineers representing100% of the respondents were completely satisfied with their repaired jobs in the workshops. All service engineers were satisfied with the quality of repair works. This implies that customers who patronize the services of these dealerships would have value for service. These findings are in agreement with other results pertaining to standard of repair works from dealerships in the country.

Table 4.43 Service Engineer's Satisfaction on Repair Work

Category	Service Engineers	
Satisfaction	**Response**	**Percentage%**
Satisfied	5	100
Neutral	0	0
Dissatisfied	0	0
Total	5	100

Diagnostic Procedures

As shown in table 4.44, the respondents were asked whether the technicians followed diagnostic procedures contained in the service manuals during diagnosis. The categories considered were all of the time, often, sometimes and not at all. The study showed that one engineer representing 20% of the respondents stated that their technicians followed diagnostic procedures all the time. Four engineers representing 80% of the respondents often used diagnostic procedures.

Table 4.44 Diagnostic Procedures

Category	Service Engineers	
Diagnostic Procedures	**Response**	**Percentage%**
All the Time	1	20
Often	4	80
Sometimes	0	0
Not at all	0	0
Total	5	100

4.2.4 Results of Questionnaire from Drivers

The following section presents the responses from drivers in Accra, to verify if they pay particular attention to the vehiclesthey are driving, and their styles of driving.

The majority of the motorists interviewed in Accra drive commercial vehicles rather than private own vehicles. This is illustrated in table 4.45, which shows how the respondents responded onwhat type of vehicle they drive? The majority of the respondents numbering seven drivers representing 70% were commercial drivers, while the remaining three drivers representing 30% of the respondents were private car owners.

Table 4.45 Vehicle Type used by the Driver

Category	**Drivers**	
Type of Vehicle	**Response**	**Percentage%**
Commercial Vehicle	7	70
Private Vehicle	3	30
Total	10	100

Maintenance Practice by the Drivers

Respondents were asked on maintenance practice. This is necessary because maintenance has a bearing on road accident. The categories considered were preventivemaintenance, breakdownmaintenance and predictive maintenance. The table 4.46 shows how the respondents responded.

According to the responses, majority of the respondent‟s eight drivers representing 80% practiced breakdown maintenance, while the remaining two drivers representing 20% practiced preventive maintenance. The study showed that none of the respondents practiced predictive maintenance. The respondents were further asked to state why they adopted a particular maintenance practice. The study revealed that those who practiced breakdownmaintenance stated that, the reason for that maintenance practice arose out of high

cost implications and that they cannot afford the cost of preventive maintenance. With regards to those who practiced preventive maintenance, the reason being ensuring that the useful working life and safety of the vehicles are maintained.

Total 4.46 Maintenance Practice by the Drivers

Category	**Drivers**	
Maintenance Practice	**Response**	**Percentage%**
Preventive	2	20
Breakdown	8	80
Predictive	0	0
Total	10	100

Vehicle Condition Checks by Drivers

It is important that all drivers be made to fully understand the need for carrying out basicchecks on vehicle condition. The study attempted to find out whether the drivers performed basic vehicle condition checks and if any, what checks were carried out before starting the engine. Table 4.47 presents the responses of the respondents on the basic checks before starting the engine.

Table 4.47 Vehicle ConditionChecks by Drivers

Category	Drivers	
Vehicle Checks	**Response**	**Percentage%**
Oil Level	3	30
Water Level	1	10
Fluid Level	0	0
Fuel Level	1	10
None	7	70

The results showed that majority of the respondents numbering seven drivers representing 70% did not check any item before starting the engine, while three drivers representing 30% of the respondents checked only engine oil level. One driver representing 10% each of the respondents indicated water and fuel levels respectively. These checks should have been carried out by all drivers prior to starting vehicle engine. The study further revealed that most of the respondents did not know what types of checksshould be carried out after starting the engine.

In the analysis, it is more apparent that, the respondents have no knowledge on essence of carrying out checks in order to discover any problem or defect on the vehicle.

With regards to the question on what driver must be constantly listening to while driving the vehicle, all the respondents mentioned noise under the vehicle and from the engine.

Walk-Around Checksby Drivers

The study also explored the respondents‟ perspectives on the effectiveness of carrying out daily walk-around check before embarking on a journey with the aim of answering the question: Do you carry out daily walk-around the vehicle to observe the state of the vehicle before embarking on a journey? Walking around the vehicle is a very important element for

ensuring vehicle safety and detection of any eminent failure and leakages. When walking round the vehicle for checking items, one is observing to ensure that, every system is secure, in good condition, and working perfectly. The study showed that majority of the respondents eight drivers representing 80% did not consider carrying out regular walk-around vehicle checks prior to embarking on journey,whilst two drivers representing 20% of the respondents said yes, which implies that, they observed for any leakage as indicated in table 4.48. The drivers claimed that walk-around checks are carried out during maintenance and that they relied on regular servicing. The daily and weekly checks on key areas such as oil levels, water level and lights were not taken care of. The other important checks on tyrepressures and its condition and braking systemswere also not carried out.

Table 4.48 Walk-around Checks by Drivers

Category	**Drivers**	
Walk-Around Checks	**Response**	**Percentage%**
Carrying out walk- Around Check	2	20
Do Not Carrying out walk- Around Check	8	80
Total	10	100

The study further attempted to find out from the drivers what items they checked during walk-around observation. The respondents,who said yes,checked water level and its leakage, engine oil level and its leakage and tyres conditions.

The respondents also stated that, the main reason for carrying out walk-around check of vehicle was to ensure that there were nosign of fluid leaks such as oil, brake fluid, coolant and that the vehicle are safe for embarking on a journey.

Regular Tyre Checks by Drivers

Checking vehicle tyres regularly could play a decisive role in curbing road accidents resulting from tyre burst. The question on checking of tyre condition was used to determine how drivers check their tyres. Checking tyres only takes a few seconds, but many drivers struggled to make sure that their tyres are being checked. It is important to state that tyres play a crucial part in the handling and running performance of a vehicle. If they are worn, active safety systems such as anti-lock braking system, traction control or vehicle dynamic control system can be less effective or even useless in an emergency. The study revealed that only one driver representing 10% of the respondents checked their tyre conditions, while majority of tendrivers representing 90% of the respondents at times do not check their tyres before driving, referred to table 4.49.

Table 4.49 Regular Tyre Checks by Drivers

Category	**Drivers**	
Tyre Checks	**Response**	**Percentage%**
Always	1	10
At times	9	90
Total	10	100

The basic tyre checks which include the following were not followed by the respondents:

- Checking tyres regularly for damage. Any damage must be checked by a tyre expert and any necessary repairs or replacements carried out immediately.
- Tyre treads should be kept free of stones and other objects.
- Checking tyre valves carefully. Ensure caps are in place and that there is no evidence of cracking or damage to the valve stem.
- Tyres deteriorate with age which increases the risk of tyre failure.
- Cracking/crazing on the side wall of the tyre, caused by its flexing

- Distortion of tyre tread
- Deformation of the carcass of the tyre
- There may also be a deterioration of ride quality caused by vibrations through the tyre.
- Poor tread depth can indicate a tyre needs replacing, as treads generally wear out before age affects their performance. However, the age of a tyre will affect its safety and increase the risk of failure; tyres should be inspected regularly for signs of aging.

Checking Tyre Pressure by the Driver

Checkingof tyre pressure was to elicit responses from the respondents, whether they regularly check their tyre pressures. Checking of tyre pressures is necessary because a vehicle with flat tyre on the road could pose a hazard to other road users. The result showed that the four drivers representing 40% of the respondents checked their tyre pressures regularly, while the remaining six drivers representing 60% did not have any schedule for checking their tyre pressures as indicated in table 4.50.

Table 4.50 **Checking Tyre Pressure by the Driver**

Category	**Drivers**	
Tyre Pressure	**Response**	**Percentage%**
very often	4	40
Rarely	6	60
Total	10	100

When the commercial drivers were further asked to state whether they check the tyre pressure before or after loading, the respondents stated that they at times checked their tyre pressures before loading the vehicle.

Tyre Markings for Maximum Load and Speed Rating for Drivers

Tyres are specified by the manufacturer with a maximum load and speed rating. Loads and speed exceeding the rating can result in unsafe conditions that can lead to steering instability and even rupture. Table 4.51 below displays the percentages of responses to question on tyre markings. The question was aimed at establishing the degree to which the respondents understood the need for tyre marking as a major consideration when replacing worn-out tyres. In other words, the influence tyre markings had on promoting safe driving on the road.

Table 4.51 Tyre Markingsfor Maximum Load and Speed Rating for Drivers

Category	**Drivers**	
Tyre Markings	**Response**	**Percentage%**
Consider Tyre Markings	0	0
Not considered	10	100
Total	10	100

The study revealed that none of the respondents considered tyre markings during tyre replacement. It is important to state that the study of vehicle dynamics starts with the interaction between the tyres of the vehicle and the road. A large portion of all of the loads on the vehicle can be tracked back to the loads on the tyres. In the analysis of most of the road accident, it can be said that some of these accident could have been caused by poor selection of suitable tyres.

Tyre Replacement by Drivers

The majority of the respondent"seight drivers representing 80% preferred using used tyres rather than the new tyres. This was illustrated in table 4.52, which shows how the respondents responded to the question on whether they replaced brand new tyres or used tyres whenever the tyres worn-out.

Table 4.52 Tyre Replacement by Drivers

Category	Drivers	
Tyre Replacement	**Response**	**Percentage%**
Brand New Tyres	2	20
Used Tyres	8	80
Rethreaded Tyres	0	0
Total	10	100

As shown in table 4.52, only two drivers representing 20% of the respondents used brand new tyres, while none used rethreaded tyres.

As drivers look for ways to run their vehicles, the financial and environmental cost of regularly replacing tyres can be an issue. Drivers may consider rethread tyres as a cost-effective and environmentally-friendly way to ensure tyre safety. Rethreading is the generic term for tyre remanufacturing. It extends the life of a worn tyre by replacing the tread rubber. This is followed by a series of rigorous tests to ensure that rethreaded tyres meet the same safety standards as new ones.

Tyre Rotation by the Driver

The tyre rotation in the survey intended to reveal whether the respondents perform this task. The table 4.53 showed how the respondents responded to this question. Rotating tyres periodically is an essential part of tyre maintenance and safety.

Table 4.53 Tyre Rotation by the Driver

Category	Drivers	
Tyre Rotation	**Response**	**Percentage%**
Always	6	60
Rarely	4	40
Total	10	100

According to the responses six drivers representing 60% of the respondents always carried out tyre rotation; while four drivers representing 40% of the respondents rarely rotate their tyres. Front tyres, especially on front wheel drive vehicles, have a tendency to wear out more quickly than rear tyres. Routine maintenance including tyre rotation (exchanging the front and rear tyres with each other) is often done periodically to facilitate uniform tyre wear.

Brakes Checked by Drivers

The importance of vehicle braking cannot be overemphasized.

Table 4.54 presents the responses of the respondents on how often they checked their braking system. The categories of brake checks intervals were during servicing, weekly, monthly and if faulty.

Table 4.54 Brakes Checked by Drivers

Category	Drivers	
Brake Checks	**Response**	**Percentage%**
During Servicing	4	40
Weekly	0	0
Monthly	1	10
If Faulty	5	50
Total	10	100

It indicated that four drivers representing40% of respondents carried out brake checks during servicing, while none of the respondents checked brake weekly. Half of the respondent‟s

numberingfive drivers representing 50% carried out brake checks whenever it was faulty. The remaining one driver representing 10% claimed that they check it monthly.

The study further asked the respondents to state whether during repair works on brakes they replace the brake pad/shoe with new or re-lined. If brake re-lining is carried out, it is important to ensure that skilled and qualified personnel perform the re-lining procedures and use quality components. The result showed that four drivers representing 40% of the respondents used new brake pad/shoes, while the majorityof six drivers representing 60% of the respondents used the re-lined pad/shoe

4.3 The Results of Interview from Garage managers

This section showed the analysis of interview conducted on five independent garages in Accra. The garages interviewed were Divine Motors, Senyo Fitting Workshop, Amico Mechanical Workshop, Gok Automobile Workshop, and Shitsi Motors, all in Accra.

Interview on Maintenance Procedures

The garage owners were asked whether they followed the standard maintenance procedures contained in the service manuals during repair works. The study showed that none of the respondents followed standard maintenance procedures contained in the service manual. The study further revealed that the respondents do not even understand what standard maintenance procedures are. To most of the drivers, maintenance is just changing engine oil and filters.

Interview onAvailability of Service Manuals

Service manuals play an important role in ensuring that repair works are carried out according to the standard procedures. The respondents were asked whether they have service manuals for the vehicles they worked on. Since the use of service manuals during repair works is an important element of good quality work. The result indicates that these independent garage owners do not have service manual.

Interview onDiagnostic Equipment

Lack of appropriate tools and equipment affect the quality repair works. This is due to the fact that technological advancement has brought several changes and modifications in automobile systems. Within this contest of reducing road accident through efficient vehicle maintenance, it is important to emphasize the need for the right tools and equipment for the repair work. The study was to find out whether the respondents have the right tools and equipment in their garages. The study revealed that the garages have basic technical tools for repairs but lacked the special service tools and state of the art equipment for fault diagnosis.

Interview on Availability of Genuine Spare Parts

With the increasing intensification of the international and domestic market competition in automotive industry, the after-sales service has become a major profit source in the automotive industry. Repairs and maintenance are important part in the after-sales service, it directly determines customers' satisfaction and loyalty, and the dealership is the main bearer of this link. Efficient and cost effective after-sales service and spare-parts availability is an important differentiator between a successful dealership and other competitors. The respondents were asked whether they stocked genuine spare parts for repair works. This is because genuine parts are easier to fit. Thiscan be guarantee that genuine parts will fit the vehicle as they are designed to be an exact fit. Fake spare parts might not fit properly, and even though the vehicle might still work, it could well cause problems at a later time. When using genuine parts one can be assured that they will be of higher quality than non-genuine parts in the market, and they will have stricter quality standard tests to pass. Many Non-genuine parts will often be of lower quality. Also, one can rest assured that genuine parts will work perfectly and that they will last longer than non-genuine ones. The result showed that the independent garage owners had non-genuine and used spare parts from the local market due to the high cost of the genuine parts from the dealership.

Interview on Quality Control

Successful automobile garages inevitably place great emphasis on managing quality control- carefully planned steps taken to ensure that the repair works carried out are consistent and reliable and truly meet their customers‟ needs. Dealerships have entire departments of highly trained technicians to carry out quality control checks. The study showed that none of the independent garages had quality control officer to ensure that required maintenance quality standards are adhered to. The respondents also claimed that all repair works are supervised and therefore required no quality control officer. Poor quality repair works could have a great impact on maintenance in an automobile dealership.

4.4 Results of Observation

In order to confirm whether the maintenance check list was followed in completing routine maintenance service, check list was designed to monitor maintenance of vehicle in various garages in Accra.Five selected independents garages were visited two times each to observe their maintenance practices on vehicle for effective and efficient maintenance and repair works on vehicle.Table 4.55 showed data on check list for ten vehicles observed during their maintenance services. According to the table, four mechanics representing 40% of the respondents observed during the periodic maintenance service checked the lighting system, while five mechanics representing 50% checked the horn. With regards to wiper and windscreen washer, only four mechanics representing 40% of the respondents checked wiper operations, while majorityof nine mechanics representing 90%of the respondents checked all the fluid levels especially; oil level, coolant level, brake fluid level and power steering fluid level. Five mechanics representing50% of the responses checked drive belts. Although, the right tool was not used to check the drive belt, they just used their hand to press it down for tension, it was laudable.An unusual pattern emerged in the checking of brake wear and leakage. Four mechanics representing 40% of the respondents checked braking system. It is important to note that when it comes to vehicle‟s safety, brakes top the list of all systems on

the vehicle, that need monitoring. However, many mechanics are unaware of the dangers that their inaction may pose to vehicle"s user with faulty brakes.

Table 4.55 Maintenance Check List

Check List	Divine Motors	Senyo Fitting Shop	Amico Mechanical Shop	Gok Automobile Workshop	Shitsi Motors	Percentage %
Lights	1		1		2	40
Horn	2	1	1		1	50
Wiper/Washer			1	2	1	40
Brake/clutch pedal travel						
Meters and gauges						
Headlight aim						
Seat Belt						
Fluid Levels	2	2	2	2	1	90
Drive belt		1	2		2	50
Hoses and pipes						
Battery						
Brake wear and leak		1	1		2	40

The result further showed that brake pedal travel, meters and gauges, headlight aim, seat belt, hoses and pipes and battery were not checked during the periodic maintenance service. This is a confirmation that independent garage operators do not have knowledge on what is entailed in the periodic maintenance schedule and therefore did not check more than 50% of the items. Following maintenance schedule can help keep the vehicle safe and reliable.

Maintenance schedules are developed by each manufacturer to highlight the recommended minimum maintenance requirements.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings, conclusion, and recommendations of the study.

5.2 Summary of findings

The following are the findings of the study:

- The study shows that, majority of mechanics were trained at independent garages,for longer years, giving them experience on try and error method of diagnosing and repairing vehicle.
- There was a clear indication that, low level educational background makes it difficult for mechanics to use vehicle manual to do standard maintenance and repair work.
- It was discovered that, most of the spare parts used for maintenance and repair works are bought from local market which are full of,fakespare parts andused spare parts, contributing to failure of vehicle parts and causing vehicular accident.
- It was also detected that, majority of mechanics are not conversant with the latest technological advancement in automobile sector and therefore cannot confidently repair and work on vehicles with electronic systems.
- It was found that, most of the light duty vehicles which were mostly commercial vehicle are repaired and maintained by mechanics in independent garages.
- The study revealed that, all technicians had high level of education which enables themto use service manual for quality work on vehicle maintenance process.
- It was detected that, most technicians work with vehicle dealership, whilst most of mechanics work with independent garages.
- It was also found out that most technicians do prevention maintenance rather than predictive maintenance in process taking shortcut or doing haphazard maintenance.

- It was exploredthat dealerships organised technical trainings periodically on new models, standard training programmes and diagnostic training for all their technicians.
- Lack of appropriate tools and equipment could affect technicians in carrying out proper diagnosis on the vehicle. This is due to the fact that technological advancement has brought several changes and modifications in automobile systems.
- Within this contest it is noted that an important issue of workforce development and equipment are needed to ensure that resources are developed to such an extent that the achievement of desired rate of technological changes will not be impeded through lack of personnel with suitable skills and equipment. The study revealed that the dealerships had the requisite tools and equipment.
- It is important to state that vehicle maintenance has an effect on road accident. The study revealed that majority of the drivers (80%) practised breakdown maintenance service, while the remaining 20% practised preventive maintenance.
- The interview with the garage managers also revealed that, none of them followed standard maintenance procedures contained in the service manual. They do not even understand what standard maintenance procedures are.
- Most of the garage managers or independent garage owners do not have service manual. To them consulting vehicle manuals does not make you knowledgeable in your field of specialization, and it is also a waste of time in referringto the manual.
- The interviewed also revealed that the garages have basic technical tools but lacked the special service tools and state of art equipment for fault diagnosis.
- The maintenance observation revealed that, all maintenance carried out was done partially. The brake wear, pedal travel, headlight aim, seat belt, hoses, pipes, and battery were not checked during periodic maintenance service. To them periodic

maintenance is to change engine oil, oil filter, and at times blow dust from the air cleaner.

5.3 Conclusion

There was lack of effective and efficient maintenance of vehicle, and the use of fakespare parts and expired home used spare parts, causingvehicle accident on our roads. The road traffic accident, gives a clear picture that Ghana needs to make pragmatic effort to address the current road safety problem. It was clear that the independent garage operators mostly mechanics with long service, ancientexperience in automotive industry are not doing so well in vehicle maintenance schedule. They mostly practice corrective maintenance, and the try and error method.The study showed that the majority of the wayside garages sourced their spare parts from the local market. This is quite a substantial percentage considering that most of the spare parts from the local market are either used spare parts or non genuine spare parts. On the other hand, the dealerships had most of their spare parts supplied from the manufacturer which are genuine spare parts.Lack of knowledge in diagnosing vehicle faults with diagnostic tools is also another factor hindering the effective maintenance of vehicle which is causing vehicle accident. It is common to see the production of leaf springs (a suspension device, besides supporting the weight of avehicle, the leaf springs control the ride height and keep the tyres in contact with the road) and castings for replacement of worn out parts at AbosseyOkai from steel scraps without any materials compositional analysis, none structural analysis, microstructure and composition determines the properties of engineering materials. Furthermore no destruction or non-destructive test is done to ascertain the susceptibility of micro cracks that can lead to structural failure.

In Ghana, the importation of vehicles with highly sophisticated systems has necessitated the need for the requisite tools and equipment for carrying out repair works and maintenance in automotive workshop. Lack of appropriate tools and equipment are affecting technicians in carrying out proper diagnosis on the vehicle. This is due to the fact that technological

advancement has brought several changes and modifications in automobile systems. Within this contest it is noted that an important issue of workforce development and equipment are needed to ensure that resources are developed to such an extent that the achievement of desired rate of technological changes will not be impeded through lack of personnel with suitable skills and equipment. The solution is to organise a technical training programmes to update mechanics knowledge and skill on vehicle maintenance procedures through the use of service manuals.

With the current road accident situations in Ghana, the stakeholders have not been able to win the fight against road crash fatalities. It is important to state that vehicle maintenance has effect on road accident. The study concluded that majority of the drivers practised mostly breakdown maintenance service, while the remaining few practised partial preventive maintenance which has caused vehicle accident.

Again,drivers‟ lackof maintenance culture which is militating against the smooth operations of most of them when they refuse todo maintenance because ofdesire to get rich quickly.It was realized that, majorityof the drivers have not carried out vehicle condition checks, likeperforming basic vehicle condition checks, checks before starting the engine,brakes and, tyres checks when embarking on journey. To them, “if the vehicle sparksand runs,it is in good condition”‟, they do not have problem. They have no knowledge on essence of carrying out checks in order to discover any problem or defect. As drivers look for ways to run their vehicles, the financial and environmental cost of regularly replacing tyres can be an issue. It was clearly showed that most drivers replaced their tyres with expired used ones, whichalways burst at high speed causing vehicle accident.

The major challenge in automobile industry is the creation of highly skilled human resource, as lack of maintenance culture which is militating against smooth operations of most of the mechanics. The independent garages lack technicians who can diagnose faults on vehicles

with sophisticated electronic system as ordinarymechanics cannot keep up with the latest technological advancement in automobile industry.

It was therefore concluded that vehicles acquired for transportation get involvedin vehicle accident through lack of effective and efficient maintenance of vehicle.

Another conviction is that due to non-availability and non-affordability of genuine spare parts,mechanics and vehicle owners resorted to using „home-used" spare parts and fake spare parts when conducting maintenance services.

5.4 Recommendations

The following recommendations are made to address the findings of the study:

- Mechanism be put in place for a constant seminars, workshops and conferences should be organized for wayside mechanics and trainees to keep them abreastwith the new developments in the automobile industry. The focus should be on electronic engine management system, electronic diagnostic procedures, noise and vibration diagnosis, electronic stability program and vehicle tracking and navigation systems.
- The operators of garages and the technicians/trainees should periodically undergo appropriate technical training to update their knowledge and skills on vehicle maintenance procedures through the use of service manuals.
- The garage owners should procure the requisite tools and equipment for their maintenance and repair works in order to deliver the highest level of quality service to their customers.
- The government should put in place a regulatory body or instituted to regulate and evaluate the operation of motor vehicle garages in the country.
- Vehicle registration Data Management System should be provided for MTTU Police to easily track the owners of vehicles and installation of Speed Radars to check over speeding drivers.

- Driver and Vehicle Licensing Authority should include Hazard Perception Test in their testing prior to license acquisition or renewal for drivers.
- Introduction of point system for traffic offenders. Some severe driving offences will incur a strike on one's license. This is logged in a Central Police Database, and if one exceeds the maximum number of strikes, the license is lost, but can ultimately be re-acquired.
- Driver and Vehicle Licensing Authority must ensure that vehicles which are issued with Roadworthy Certificate are really roadworthy vehicle

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Appendix A

Questionnaire for mechanics

The researcher is a student of the University of Education, Winneba offering Master in Technology programme in Mechanical Technology. As part of the study, the researcher is conducting research on the topic," Prevention of Accidents through Effective and Efficient Maintenance and Repair Work in various Garages in Accra"", and need your contribution to complete the dissertation.

Please feel free to respond to the questions.

Your contribution will be confidential.

Thank you.

Q1. What is your educational level?

Primary [ ]

JSS/MLSC [ ]

SSS/Technical [ ]

None [ ]

Q2. Where have you done your apprenticeship?

Dealership [ ]

Wayside garage [ ]

Vocational institute [ ]

Technical School [ ]

Q3. How long were you trained on the job as mechanic?

One year [ ]

Two years [ ]

Three years [ ]

Four years [ ]

Five years and over [ ]

Q4. How long have you been working as a mechanic?

1 -5yrs [ ]

5 – 10yrs [ ]

10 – 15yrs [ ]

15 – 20yrs [ ]

20yrs and over [ ]

Q5. Who are your loyal customers?

Individuals [ ]

Corporate Entities [ ]

Government Agencies [ ]

Q6. Which type of maintenance do you perform?

Time Based [ ]

Distance Based [ ]

Q7. How do you assess the condition of the vehicle parts before replacement?

Visual inspection [ ]

Testing [ ]

Q8. How do you obtain spare parts for your repair works?

Dealers [ ]

Local market [ ]

Q9. What spare parts do you use?

Genuine [ ]

Non genuine [ ]

Used [ ]

Q10. How often do supervisors guide you when carrying out repair and maintenance works?

All of the time [ ]

Very often [ ]

Often [ ]

Sometimes [ ]

Hardly ever [ ]

Q11. Were you trained on how to use diagnostic equipment?

Trained onhow to use of diagnostic equipment [ ]

Not trained on how to use diagnostic equipment [ ]

If yes, specify the type of diagnostic equipment?

Name of Equipment: ……..

Q12. Did your "Masters" train you on how to perform vehicle diagnosis?

Yes trained on performing diagnosis [ ]

Not trained on performing diagnosis [ ]

Q13. Do you think you can repair and service vehicles with highly sophisticated electronic systems?

Yes can repair electronics system [ ]

Cannot repair electronics system [ ]

Appendix B

Questionnaire for Technicians

The researcher is a student of the University of Education, Winneba offering Master in Technology programme in Mechanical Technology. As part of the study, the researcher is conducting research on the topic, "Prevention of Accidents through Effective and Efficient Maintenance and Repair Work in various Garages in Accra"", and need your contribution to complete the project.

Please feel free to respond to the questions.

Your contribution will be confidential.

Thank you.

Q1. Academic/professional qualifications held?

MVM [ ]

Technician [ ]

Diploma [ ]

Bachelor Degree [ ]

Q2. Where were you trained as a technician?

Dealership [ ]

Vocational institute [ ]

Technical School [ ]

Polytechnic [ ]

Q3. How many years have you been working as a technician?

Below 1 [ ]

1 – 5 [ ]

6 – 10 [ ]

11 – 15 [ ]

Above 15 [ ]

Q4. Which of the following type of vehicles do you usually work on?

Saloon [ ]

Cross Country [ ]

Pick-ups [ ]

Light Duty Trucks [ ]

Heavy Duty Trucks [ ]

Q5. What type of maintenance plan do you carry out?

Preventive [ ]

Breakdown [ ]

Predictive [ ]

Q6. Which type of maintenance do you perform?

Time Based [ ]

Distance Based [ ]

Q7. Who are your loyal customers?

Individuals [ ]

Corporate Entities [ ]

Government Agencies [ ]

Q8. How do you assess the condition of the vehicle parts before replacement?

Visual inspection [ ]

Testing [ ]

Q9. How do you obtain spare parts for your repair works?

Dealers [ ]

Local market [ ]

Q11. What spare parts do you use?

Genuine [ ]

Non genuine [ ]

Used [ ]

Q12. How do you differentiate between genuine and non-genuine parts?

……

……

Q13. How often do supervisors guide you when carrying out repair and maintenance works?

All of the time [ ]

Very often [ ]

Often [ ]

Sometimes [ ]

Hardly ever [ ]

Q14. Are you train on how to use vehicle maintenance procedures in the service manual?

Use of service manual [ ]

Not trained on service manual [ ]

Q15. Were you trained on how to use diagnostic equipment?

Use of diagnostic equipment [ ]

Not trained touse diagnostic equipment [ ]

If yes, specify the type of diagnostic equipment?

Name of Equipment: ……..

Q16. Did your supervisors train you on how to perform vehicle diagnosis?

Use of diagnostic tool [ ]

Not trained to use diagnostic tool [ ]

Appendix C

Questionnaire for Engineers

The researcher is a student of the University of Education, Winneba offering Master in Technology programme in Mechanical Technology. As part of the study, the researcher is conducting research on the topic, "Prevention of Accidents through Effective and Efficient Maintenance and Repair Work in various Garages in Accra", and need your contribution to complete the project.

Please feel free to respond to the questions.

Your contribution will be confidential.

Thank you.

1. Academic/professional qualifications held?

Diploma [ ]

Bachelor Degree [ ]

Masters Degree [ ]

Other [ ]

Q2. During maintenance operation, non-genuine parts are always used.

Strongly agree [ ]

Agree [ ]

Disagree [ ]

Neither [ ]

Q3. Do you have technical training programmes for your technicians?

Technical Training programme for technicians [ ]

No Technical Training programme for technicians [ ]

Q4. If yes, what is the scope of the training programme?

……

……

Q5. How often do you evaluate your technicians?

Use very often [ ]

Often [ ]

Sometimes [ ]

Rarely [ ]

Never [ ]

Q6. How often do technicians generally attempt to go through diagnostic procedures contained in the service manuals during diagnosis?

Very often [ ]

Often [ ]

Sometimes [ ]

Rarely [ ]

Never [ ]

7. How true is it that technicians don‟t follow standard servicing procedures outline in the service manual?

Very true [ ]

Somewhat true [ ]

Not very true [ ]

Not at all true [ ]

Q8. How often does the workshop organize technical meetings on quality issues?

Very often [ ]

Often [ ]

Sometimes [ ]

Rarely [ ]

Never [ ]

Q9. The Workshop Manager seriously considers staff suggestions for improving the quality of repair jobs in the workshop.

Strongly agree [ ]

Agree [ ]

Most of the time [ ]

Disagree [ ]

Strongly disagree [ ]

Neither [ ]

Q10. There are effective rewards for exceptional work and incentives to avoid mistakes.

Strongly agree [ ]

Agree [ ]

Most of the time [ ]

Disagree [ ]

Strongly disagree [ ]

Neither [ ]

Q11. Whenever pressure builds up, the Workshop Manager wants the technicians to work faster, even if it means taking shortcuts in completing the jobs.

Agree [ ]

Disagree [ ]

Neither [ ]

Q12. Staff will freely speak up if they see something that may negatively affect the quality of the repair works.

Most of the time [ ]

Sometimes [ ]

Always [ ]

Rarely [ ]

Never [ ]

Q13. How satisfied are you with the standard of repair works in the workshop?

Completely satisfied [ ]

Somewhat satisfied [ ]

Neutral [ ]

Somewhat dissatisfied [ ]

Completely dissatisfied [ ]

Q14. Qualified technicians are lacking in your workshop?

Strongly agree [ ]

Agree [ ]

Neither [ ]

Disagree [ ]

Strongly disagree [ ]

Q15. The workshop has all the tools and equipment for carrying out the necessary maintenance and repairs.

Agree [ ]

Disagree [ ]

Q16. What type of diagnostic equipment do you have in your workshop?

……

……

Q17. What factors relating to special service tools contribute to maintenance problems in the workshop?

……

……

AppendixD

Questionnaire for Drivers

The researcher is a student of the University of Education, Winneba offering Master in Technology programme in Mechanical Technology. As part of the study, the researcher is conducting research on the topic "Prevention of Accidents through Effective and Efficient Maintenance and Repair Work in various Garages in Accra", and need your contribution to complete the project.

Please feel free to respond to the questions.

Your contribution will be confidential.

Thank you.

Q1. What type of vehicle do you drive?

Private [ ]

Commercial [ ]

Q2. What maintenance practice do you adopt?

Preventive [ ]

Breakdown [ ]

Predictive [ ]

Q3. Do you carry out daily walk-around check before embarking on journey?

Daily walk-around check on vehicle [ ]

Nodaily walk-around check on vehicle [ ]

Q4. If yes, what items do you check?

……

……

Q5. What is the main reason for carrying out walk-around check of your vehicle?

……

……

Q6. When walking round your vehicle checking items, do you always check the condition of your tyres?

Checking condition of tyres [ ]

Condition of tyres not checked [ ]

Q7. Do you consider tyre markings and rating during tyre replacement?

Consider tyre markings during replacement [ ]

Do not consider tyre markings [ ]

Q8. Do you replace brand new tyres or used tyres whenever the tyres are worn-out?

New tyres [ ]

Used tyres [ ]

Rethreading tyres [ ]

Q9. How often do you check your brakes?

During servicing [ ]

Weekly check [ ]

Monthly check [ ]

If faulty [ ]

Q10. Do you replace new brake pad/shoe or re-line?

New [ ]

Re-lined [ ]

APPENDIX E

Interview for Workshop Managers

1. Do you follow maintenance procedures describe in the service manual?
2. Do you have service manuals for vehicles you work on?
3. Do you have diagnostic equipment for your repair works?
4. Do you have genuine spare parts for your repair works?
5. Do you have quality control officer for ensuring that repair works are done to the required standards in your garage?

APPENDIX F

OBSERVATION CHART

Check List	**Divine Motors (Circle) Accra**	**Senyo Fitting Shop (Alajo) Accra**	**Amico Mechanical Shop AbekaLapaz**	**Total Fliling Station Near 37 Millitary Hospital**	**Shitsi Motors (Osu) Accra**
Lights					
Horn					
Wiper/Washer					
Brake/clutch pedal travel					
Meters and gauges					
Headlight aim					
Seat Belt					
Fluid Levels					
Drive belt					
Hoses and pipes					
Battery					
Brake wear and leak					