TECHNICAL COMPETENCIES NEEDED BY MOTOR VEHICLE MECHANIC CRAFTSMEN IN THE SERVICING OF ENGINE COOLING AND LUBRICATING SYSTEMS IN MINNA METROPOLIS OF NIGER STATE

BY

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2016/1/61976TI

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MINNA, NIGER STATE

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN-PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY DEGREE (B.TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION.

APRIL, 2023

DECLARATION

I, MUOKWE PATRICIA with matric No.**2016/1/61976TI** an undergraduate student of the Department of Industrial and Technology Education certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

MUOKWE Patricia _____

2016/1/61976TI Signature and Date

CERTIFICATON

This project has been read and approved as meeting the requirement for the award of B.Tech in Industrial and Technology Education, School of Technology Education, Federal University of Technology Minna.

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Head of Department Sign/Date

_____

External supervisor Sign/Date

DEDICATION

This research work is dedicated to God Almighty, who gave me the intellectual wisdom, ability, zeal, courage, strength, knowledge and understanding to be able to carry on to completion, to my incredible and awesome parents Mr. & Mrs. Emeka Paulinus Muokwe for their intense prayers, encouragements, love, support, provisions showed upon me.

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Abstract

This study was designed to examine the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system in Minna metropolis of Niger State. Three research questions and two hypotheses guided the study. A descriptive survey research was employed for the study. 30 items structured questionnaire was developed by the researcher and validated by 3 experts was used for the data collected for the study. A total of 170 respondents comprising of 100 highly experienced and 70 moderately experienced motor vehicle mechanic craftsmen was used as a total population for the study. Mean and standard deviation were the statistical tools used to analyze the data collected for the study. While t-test was used to test the two null hypotheses formulated for the study at 0.05 level of significance. The findings revealed among others that the respondents agreed with all the 12 items as the technical competences were highly needed by Motor Vehicle Mechanic craftsmen in the servicing of engine cooling and lubricating system. Findings also revealed that the respondents agreed with all 8 items as the challenges encountered by Motor Vehicle Mechanic craftsmen in the servicing of engine cooling and lubricating system. Finally, it was revealed that the respondent agreed with all 10 items as the strategies that could be adopted to improve the technical competencies of Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems. Based on the findings, it was recommended that the National Automotive Council (NAC) should create means of sensitizing the craftsmen in order to maintain standard and effective ways of carrying out vehicle servicing works.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Automobiles have experience a tremendous growth in the automotive industries all over the world. As the years gone by, there has been enormous technological improvement to the modern day vehicle design for it to be safer, easier, efficient and pleasing to the customer. Giri (2012) describe automobile as a self-propelled vehicle used for transportation of goods and passengers on land and so therefore it can be described as the innovation that facilitates the movement of humans, animals and different kinds of goods. Automobile, according to Fetherston (2002), automobile is a self propelled vehicle, used primarily on public roads. The very first self-powered road vehicle were powered by steam engines, Nicolas Joseph Cugnot of France who invented an effective gas motor engine in 1769.The early stage of highly successful and practical gasoline-powered vehicle were made by Gottlieb Daimler in 1889 and Karl Benz in 1886 which were regarded as the first practical and reliable vehicle .

The skills of automobile mechanic craftsmen are often developed contemporaneously in workshop. According to Jubril (2011), a workshop is a place, area, room or building where machines, equipments, hand tools, workbenches and materials are used in manufacturing or repairing of things and so therefore, an automobile workshop is a place where basic vehicle maintenance is being carried out by auto mechanics or motor vehicle mechanics. Practical skills referring to the ability to use tools effectively, the ability to undertake the work of the day such

as engine servicing, lubricating system servicing and cooling system servicing and the likes are the means and abilities to diagnose problems associated with servicing of automotive vehicle.

Motor vehicle mechanic as a person who, for compensation, engages in the diagnosis or repair of faulty motor vehicles components or system. Motor vehicle mechanics craftsmen possess practical skills; these practical skills are mostly required in the skills and knowledge of the necessary information. In the practice of skills, the recipients or trainee observe the master or trainer perform the operations, and through imitation, the apprentices then practice the skills until they become proficient and capable to carry out the same work been done. Tools and equipment use by most motor vehicle mechanic craftsmen were mostly outdated and this affects their ability to work on complex systems especially electronic and automatic engine cooling and lubricating systems, making them seem incompetent in carrying out their work efficiently. Motor vehicle mechanic craftsmen have shown that working experience or number of years spent with master craftsman affects the skills acquired by trainee. To become a master craftsman, you need to have strong practical skills. You need to be good at problem-solving and in faults detection. You also need to have good human relations and great customer service skills. Mechanics now make judicious use of the Internet for information to help them on how to service cooling and lubricating systems in vehicles. In servicing vehicles, the main role of the mechanic craftsmen is to detect the problems accurately and quickly for effective results.

Motor vehicle mechanic craftsmen are instrumental in social economic development of any society because they are responsible for inspecting, servicing and maintaining cars, buses, trucks, motorcycles and other auto vehicle hence they are supposed to understand the working principles of every systems and sub-systems of both conventional and modern automotive and are able to relate with each components. In the past few years, the auto industry has seen major changes in

the servicing of engine cooling and lubricating system. It has therefore become necessary to assess the skills and competencies needed by motor vehicles mechanic craftsmen in the servicing of engine cooling and lubricating systems.

Automobile engine cooling system in an internal combustion engines should be able to maintain a constant engine operating temperature, remove about 30% excess heat from the engine, increase the temperature of a cold engine as quickly as possible and also provide means for heater operation (warming the passenger's compartments). Motor vehicle cooling systems comprises of various types: water pump, thermostat, hoses, fan and belts, radiator and pressure cap. Therefore vehicle engines are designed to dissipate their heat into the air through vehicle passes which is accomplished either by direct air-cooling or indirectly by liquid cooling. the rate of cooling is dependent on the area exposed to the cooling medium, heat conductivity of the metal used, amount of air flowing over heated surfaces and the differences in temperature between the exposed metal surfaces and the cooling air.

Automobile engine lubricating system in an internal combustion engine should be able to reduce friction and wear between moving parts. Lubrication is the science of reducing friction between two solid bodies in relative motion by imposing a lubricant between their rubbing surfaces. Lubricants are available in liquid, solid, gas but liquid is the most form of lubrication in engines, it functions includes: help transfer heat and cool engine parts, clean the inside of the engine by removing contaminants and absorbs shock between moving parts to quiet engine operation and increase engine life. Therefore lubricating system could be describe as the part of an automobile that helps in reducing friction between surfaces by interposing a lubricant between the surfaces in contact (Vishwakarma, 2015). Motor vehicle lubricating system also comprises of various components or parts which include the oil pump, oil pickup and strainers carriers, pressure relief

valve, oil filter, oil cooler, oil pan, oil level gauge, oil galleries, oil pressure indicator, oil pressure gauge and oil temperature regulator. It is therefore an integral part of the engine and the operation depends upon the operation of the others. Most high-efficiency engines run without explicit cooling and lubricating system, such engines can achieve high efficiency but compromise power output, duty cycle, engine weight, durability and emissions. An engine needs lubricating systems as they plays vital in automobiles as it aids working efficiency and longevity of an engine. auto mechanics lack the ability to use modern servicing equipment, manufacturer's manuals, computers and internet which have characterized modern vehicle repairs, in their service practices. Harnessing new technologies into the motor vehicle through the use of electronic control system have made the modern automobiles vehicle an assemblage of a group of sophisticated technologies.

However, there seems to be inadequate mechanics who are experts in carrying out the right diagnosis which can save automotive owner's time and potentially a substantial amount of money. It has therefore become important to assess the practical skills of the motor vehicle mechanics craftsmen in Minna Metropolis in diagnosing, fixing problems and servicing of vehicle cooling and lubricating system and their various components. The Motor Vehicle Mechanic craftsmen ought to be with practical skills, mechanical knowledge and the ability to service and carryout repair works and maintenance of motor vehicle.

Hence, it is important the government should assist in training motor vehicle mechanics craftsmen to upgrade their knowledge and practical skills in the area of automotive electronics which can be a useful asset in the competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating systems. And as well need the assistance of Institutions and organizations such as the universities, polytechnics, monotechnics and National

Board for Small Scale Industries (NBSSI), etc., particularly in the form of education and training to equip motor vehicle mechanics craftsmen with the necessary and requisite skills and technology to be able to work on the electronic managed vehicles. With these improvements, basic understanding of the technology on the servicing of engine cooling and lubricating systems should be effectively carried out on modern vehicles.

1.2 Statement of the Problem

Motor vehicle mechanic craftsmen in servicing of engine cooling and lubricating systems ought to aim at the necessary manpower, practical skills, mechanical knowledge for diagnosing, servicing and completely repair any faults relating to the conventional motor vehicle assemble main units and systems and on how to completely carry out maintenance of motor vehicle by following the manufacturer's specifications.

However, the competences needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating systems in Minna Metropolis, plays a vital role in road transportation system in the sense that they contribute immensely and provide training opportunities to many individuals in the society. majority of the motor vehicle mechanic craftsmen in Minna Metropolis lacks the relevant knowledge about engine cooling and lubricating system component servicing and so it is difficult to know whether these craftsmen actually meets the needs of the society or if they don't meet the needs of the society.

Furthermore, most of these vehicle mechanic craftsmen seek to access the skills in the advent of automotive technology advancement and the opportunities available to those with specialized knowledge or training so as to prevent them from becoming career disabled due to the increase in vehicle technology and also the competence needed by these motor vehicle mechanic craftsmen on

motor vehicle mechanic work will reveal whether or not the required or expected change in performance skills and in the level of knowledge have been attained.

1.3 Purpose of the Study

The main aim and objectives of the study is to identify the technical competencies needed by motor vehicle mechanic craftsmen is the servicing of engine cooling and lubricating systems in Minna Metropolis of Niger State, Specifically the study sought to achieve the following objectives;

1. Find out the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating systems
2. Determine the challenges encountered by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating systems.
3. Suggest strategies that could be adopted to improve the technical competencies of Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems.

1.4 Significance of the Study

The study will be of great benefits to automobile industries, motor vehicle mechanic developers, motor vehicle mechanic students and motor vehicle mechanic craftsmen.

Automobile industries: The study will be a great benefit to the automobile industry in the employment of graduates from various institutions with proper competent skills, knowledge, desirable work attitude and keen sense of responsibility in servicing of engine cooling and lubricating system.

Motor vehicle mechanic developers: It will also provide the skills and knowledge to be included in the curriculum which will be used by teachers in educating the student in acquiring sound theoretical and practical training to meet the challenges of today's increasingly complex work environment. It will also enhance productivity and adaptability.

Motor vehicle mechanic students: This study will be of benefits to students by improving their average technological knowledge and manpower and reinforce fundamental skills through exposure to practical application, and also develop high problem solving skills in the servicing of engine cooling and lubricating system. Students would also be exposed to variety of ideas and knowledge on how to improve their working principles and on how to handle various servicing procedures in modern vehicles.

Motor vehicle mechanic craftsmen: Effective use of the finding of this study will also help in equipping the motor vehicle mechanic craftsmen with the required technical knowledge, in-service training and vocational skills and in determining the techniques to be used in solving various faults/problems in the servicing of the engine cooling and lubricating systems.

1.5 Scope of Study

The study covered the technical competencies needed by Motor Vehicle Mechanic Craftsmen in servicing engine cooling and lubricating systems by finding out the technical competencies needed by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems, the challenges encountered by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems as well as strategies that could be adopted to improve the technical competencies of Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems.

1.6 Research Questions

The following research questions guided the study;

1. What are the technical competencies needed by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems?
2. What are the challenges encountered by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems?
3. What are the strategies that could be adopted to improve the technical competencies of Motor Vehicle Craftsmen in the servicing of engine cooling and lubricating system?

1.7 Hypotheses

The following hypotheses was formulated and tested at 0.05 levels significant;

H_{01}: There is no significant difference in the mean responses of highly experienced motor vehicle craftsmen and moderately experienced motor vehicle mechanic craftsmen as regards to the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system in Minna metropolis of Niger state.

H_{02}: There is no significant difference in the mean responses of highly experience motor vehicle mechanic craftsmen and moderately experience motor vehicle mechanic craftsmen as regards, to the strategies that could be adopted to improve the technical competencies of motor vehicle mechanic craftsmen in servicing of engine cooling and lubricating system in Minna metropolis of Niger state.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

This chapter is dedicated to the findings of other researchers that are related to this research work. The literatures related to this study were reviewed under the following headings:

- Motor vehicle mechanics and its objectives
- Curriculum of motor vehicle mechanic
- Emanating technologies in servicing Engine Cooling System.
- Emanating technologies in servicing Engine Lubricating System.
- Summary of reviewed related literature.

2.1 Motor Vehicle Mechanics and its objectives

Motor Vehicle Mechanic (MVM) is a vocational trade that comprises and perform various skilled work in diagnosing, perform preventive maintenance duties, perform a variety of technical tasks , repairing and maintaining a variety of mechanical, hydraulic, and electrical systems on light, heavy and diesel power-driven vehicles and equipments. Hiller and Coombes (2004) defined motor vehicle mechanic as a skilled personnel who specialist in automobile maintenance, repairs and sometimes modification. The Motor Vehicle Mechanics must be specially trained and equipped for On-Board Diagnostics technology to avoid errors in diagnosing car trouble codes and making appropriate repairs (Malone, 2006). The use of automotive vehicles on our roads plays a key role in road transportation system and the continuous use of vehicle results in general wear, tear and breakdowns and as the parts breakdown and wear out and so must be maintained.

By the early 1980's the introduction of information technology in automotive has triggered the most rapid technological advancement in the automotive industry. With the computers available, automotive designers have developed numerous sensors and controls. Now computers have even been used as components parts for brakes, steering, chassis systems and other parts of automobile. Technologies have recently been incorporated in all new automotive subsystems and have become standard implementation on many others. The master craftsman has full control of the workshop, where the master craftsman owns all the tools, workshops and skills from which the apprentices benefit, they remain in the final analysis in the lower cadre of manpower personnel and their practical expertise degenerates into mechanical manipulation. Apprenticeship training leads to the acquisition of skills as well as basic scientific knowledge. It is a planned program and learning experiences which starts with exploration of career options, supports basic life skills, and enables achievement of high preparation for industry-defined work, and advanced and continuing education that gives learners specific occupational skills and prepares learners for careers that are based in manual activities and traditionally non-academic that relate to a trade, occupation or vocation. Specifically, it also gives individuals the skills to learn and become productive citizens and for advancement in the workplace. `

Motor Vehicle Mechanics now regularly use the Internet for information to help them in diagnosing and/or repairing vehicles. Service manuals for vehicles have become significantly less prevalent with computers that are connected to the Internet taking their position. In repairing vehicles, the main role is to diagnose the problem accurately and quickly sometimes they often have difficulty in diagnosing electronic faults. Motor Vehicle Mechanic is expected to diagnose service and completely repair any problem on the automobile. Study shows that their job may involve the repair of a specific part or the replacement of one or more parts as assemblies and so

they have to compete with large companies which use expensive diagnostic equipment and have advantages in purchasing, distribution and marketing. A skill gap analyzed that majority of the Motor Vehicle Mechanics lack the relevant knowledge about vehicle electrical, electronic components repair and ensures that technology in the auto sector advances continually at a very fast pace. The only way to catch up with this advancement is training and re-training. .they are responsible for inspecting, repairing and maintaining cars, buses, trucks, motorcycles and other vehicle. The skills of an auto mechanic will vary greatly; some develop the skills to work on all parts of a vehicle, while others choose to specialize in a particular field. A competent motor vehicle mechanic should also have mastery over a wide variety of integrated skills, such as the electrical system, fuel system and air conditioning system and have the basic knowledge on all the various skills. Computer skills are also needed in the day-to-day operations, and are as much a part of the tool box as wrenches and so knowledge gained becomes easier to move into higher paying positions which could be of use in the technologies of modern day motor vehicles.

The motor vehicle mechanic should be able to;

- Inspect, diagnose, repair and adjust variety of problems, determine the extent of the necessary repair and perform routine preventive maintenance.
- Overhaul, repair and adjust engines, transmission, clutches, differentials, carburetors, distributors and pumps; fit and adjust bearings, install axles and wheels.
- Identify mechanical faults by using computerized diagnostic equipments.
- Perform services on vehicle engines and other major components
- Diagnose, maintain and repair electrical components, ignition system, cooling system, lubrication system, alternators, starters and batteries.

- Tune up engines by replacing ignition parts, recondition and adjust carburetors and fuel injection systems, repair and maintain emission control system.
- Perform skilled mechanic duties which include troubleshooting, diagnosing and repairing gasoline and diesel powered automotive, heavy and light construction and other power-driven equipments.
- Repair, adjust and replace brake systems including wheel and master cylinders, disc pads, machine drum and rotors, hydraulic and air brakes.
- Ensuring that the testing equipments for repair and maintenance are coordinated.
- Tests performance of vehicle by driving on road and makes necessary adjustments to attain desired standard.

2.2 Curriculum of Motor Vehicle Mechanic

Motor Vehicle Mechanics (MVM) Curriculum presents the aims objectives, contents, teaching strategies, instructional facilities, and method of evaluation and one of the primary objectives is to help student develop this ability to visualize, which is so vital to problem formulation. A curriculum has variety of definitions but it aims at producing competent maintenance craftsmen and to give insight and equip the students with knowledge, attitude and skills in automobile work that can enable them to be gainfully employed after they graduate (Nigerian Educational Research and Development Council (NERDC, 2009). The general objectives are embedded for the learner to develop familiarity with the automobile, develop proper attitude towards its use appreciate the various changes in technologies that are applicable to the automobile, perform simple fault diagnosis and to effect simple routine automobile repairs (NERDC, 2009).

Curriculum according to Kelly (1999) refers to a syllabus which may limit the planning of teachers to a consideration of the content or the body of knowledge they wish to transmit or a list of the subject to be taught or both. In formal education, curriculum refer to the subject matter, and various topics (including skill, knowledge, attitude, among others), that help in achieving the objectives of programs. It is the subject matter, the professional skills, knowledge, and attitude to be learned during a program or course (Ayeni, 1990). The content which are designed and organized in modules for training of MVM using appropriate teaching strategies are: safety and maintenance, engine system, fuel system, cooling system, transmission and braking system, electrical systems (lighting system, ignition system), charging system, exhaust system, heating and ventilation system, steering and suspension system, lubrication system, and auto-air conditioning system (NERDC, 2009). Education curricula were subjected to social and political influences aimed at achieving any political or social end of the government at that time (Umoru, 1999).during the colonial masters era, curriculum were used towards achieving a vest interest and so after the independence, it became visible that the colonial education systems was no longer suitable and good enough for the Nigerian people as it has failed to produce the type of manpower necessary for the development and sustainability of the youth and society. The choice of any educational curriculum is based on the roles played by the institution. This means that curriculum must be relevant to societal needs as stated by the National Policy on Education (2004).

Furthermore, several studies have revealed that despite the curriculum was well structured, products of the programs still lacked the basic skills needed for gainful employment and self-sustenance in today's automobile industry and so it should be able to provide training on the acquisition of relevant and needed skills to meet the demand of modern technologies, related

sciences and industries. Ayeni (2006) stated that a poorly implemented curriculum will produce half-baked graduates. Federal government of Nigeria (2004) pointed out the national policy on education that the main features of the curricular activities for technical colleges shall be structured in foundation and trade modules. According to Doyin (2004) motor vehicle mechanic is a vocational education program, which is aimed at preparing one for a specific occupation. the objectives of MVM is to enable graduates to test, diagnose, service and repair any faults relating to conventional motor vehicle main assembly units and system to the manufacturer specification (NBTE, 2001).

2.3 Emanating Technologies in Servicing Engine Cooling Systems

Cooling system is very important and essential to the automobile engine, and its function is to enable the automobile to run for a long time with a performance of the engine. Modern motor vehicle internal combustion engines cooling system uses either air or liquid to remove excessive heat from the engine. The cooling system purpose is to maintain optimum temperature of the engine for efficient operation under all conditions, dissipate surplus heat for protection of engine components like cylinder, cylinder head, pistons and rings and valves, maintaining the lubricating properties of the oil inside the engine cylinder for normal functioning of the engine. The heat generate a huge amount of heat and the heat is created when the diesel fuel and air mixture is ignited in the combustion chamber and so there is an explosion which cause the piston to be forced down inside the engine, pulling the connecting rods and turning the crankshaft and so power is created. Most heat engines cause mechanical power by extracting energy from heat flows. Engines are incompetent and so more heat energy enters the engine then comes out as mechanical powers. Most internal combustion engines remove excess waste heat through cool intake of air, hot exhaust gases and direct engine cooling. Thus, all heat engines need cooling to

operate because high temperature damage engine materials and lubricants. Heat engines generate mechanical power by extracting energy from heat flows, much as a water extract mechanical power from a flow of mass falling through a distance.

Engines are inefficient and so more heat energy enters the engine then comes out as mechanical power; the difference is waste heat which must be removed. Internal combustion engines remove waste through cool intake air, hot exhaust gases and explicit engine cooling. Cooling is also needed because high temperature damage engine materials and lubricants. Internal combustion engines burn fuel hotter than the melting temperature of engine material and hot enough to set fire to lubricants. It removes energy fast enough to keep the temperature low so the engine can survive. Some engines can achieve high efficiency but compromise power output, duty cycle, engine weight, durability and emission.

Rebecchi, (2012), fluid or water that flows through internal combustion engines with objective of carrying heat away is referred to as coolant. Most internal engines are fluid cooled either by air or a liquid coolant run through a heat exchanger cooled by air. Cooling becomes important when the climate becomes hot because the internal engines burn fuels, hot enough to set the lubricants on fire. Engine cooling removes energy fast to keep the temperature so that the engine can run at a steady pace. To avoid overheating, the heat transferred to an engine components must be removed and removed to the atmosphere. Peak combustion temperature in a gasoline engine may reach as high as 4500^0F, while that of diesel engine may approach 6000^0F. the valves, pistons, cylinder walls and cylinder head which must be provided some means of cooling to avoid excessive temperature, therefore vehicle engines are designed to dissipate their heat into the air either by direct air-cooling or indirectly by liquid cooling. The servicing of air and liquid cooling system is extremely important to the performance and service life of the engine passage of air is

kept clean. This is done by cleaning the dirt accumulated in the air passage by stiff brush or compressed air. When separate fan is provided, the belt tension is to be checked and adjusted if necessary and also keeping the cooling parts components clean, locate and correct cooling system problems quickly and accurately, inspection, servicing, repairing and replacing of worn out parts of the engine cooling systems should be carried out to keep it in good working conditions. The principles of engine cooling system comprises of absorption, circulation, radiation, control and temperature Kershaw, (2019).

Components of Engine Cooling System

Below are the components of the cooling system and their function:

- Radiator: this engine cooling parts is made up of aluminum tubes and strips that zigzag between the tubes. High temperature fluid flows inside the radiator through the hose. This heat fluid is then transferred from the tube to the air stream, which is then blown away to the atmosphere
- Radiator Fan: it is located a bit after the radiator, which is closest to the engine. Choquet, (2014),The parts are designed to protect and direct flow. It blows air to the radiator to cool the hot fluid while the engine is running, so the fan helps to cool down the temperature of the radiator. Damages may occur when electric motor and sensors are not functioning (Singh, Gara, Kumar and Chaulharu, 2013).
- Radiator hoses: it carries coolant between the engine and the radiator. It can withstand the vibration and rocking of the engine without breaking due to its flexibility.
- Radiator pressure cap and reserve tank: radiators are designed with pressure cap so that pressurize coolant flow out as it expands. Thus, the function o the pressurize cap is to

maintain pressure in the cooling system up to a certain point. This cap featured a spring valve, calibrated to the correct pounds per square inch (psi).if the pressure is up higher than the set pressure points it opens and a small amount of coolant is bleed off. While reserve tank is a reservoir that collects the coolant bled off the pressurized cap. The tank is typically made with plastic and it can indicate the temperature of the coolant. Ganeshan, (2012).

- Thermostat: is simply a valve that sense or measures the temperature of the engine coolant. If the coolant is not hot enough, the thermostat remains close, but as soon as the coolant temperature reaches some specific temperature, it opens ad allows the coolant to flow through the radiator. Ebrahimi, Chen et al, Ge et al and Rahim, (2010).
- Water pump: It is a centrifugal type pump; it is centrally mounted at the front of the cylinder block. It is used to circulate coolants/ water inside the engine and it is driven by a belt which is connected to the crankshaft. The bottom of the radiator is connected to the suction of the pump and so seals of various designs are incorporated in the pump to prevent loss of coolant from the system. The centrifugal pump consists of the following parts: body or casing, impeller (rotor), shaft, bearing or bush, water pump seals and pulley.
- Antifreeze mixture: It is a mixture of a solution of ethylene and water. In order to prevent the water in the cooling system from freezing, some chemical solutions which are called anti-freeze solutions are mixed with water. If the water used in the radiator freezes, the ice formed has more volume and produces crack in the cylinder blocks, head, pipes and radiator. And so the boiling point of the anti-freeze should be as high as that of water

within a reasonable and ideal mixture which should easily dissolve in water. The materials

Types of Cooling Systems

Liquid Cooling System

It plays an important role in automobile; they serve two purposes in the working of an engine which include eliminating excess heat preventing it from overheating. Also, it keeps the engine at efficient working temperature and economical. it contains a series of channels cast into the engine block and cylinder head, surrounding the chambers with circulating water or other coolant. It is also made of a thermostat that controls the temperature of the coolant and a radiator cap to control the pressure of the system. The coolant flows to all these spots with the aid of interconnected hoses. Liquid cooling system works by transferring liquid coolant through passages in the engine block and heads. The coolant flows from the radiator to absorb excessive heat. After the coolant receives the hotness, it's transferred to the radiator through a rubber hoses. As soon as the hot coolant enters the radiator, cooling begins. The cooling is achieved by the air stream entering the engine component from the front side of the vehicle.

After the coolant is cooled, it returns to the engine to carry out the same process. The water pump helps the circulation of coolant to enter towards the hidden passages. There is the thermostat located between the engine and the radiator to ensure the coolant is heated to a certain preset temperature before entering the radiator. The thermostat remains close, if it senses cooled coolant, so instead of stopping the circulation process it hen bypass the radiator and returns to t engine.

The cooling system is designed with a pressurizing valve to prevent the coolant from boiling. Since under pressure, the boiling of the coolant will rise, the radiator cap is designed to relieve pressure if in case it exceeds a certain point. Or else, too much pressure will destroy the system components like hose and other parts.

In this system, dissipation of heat is done by the circulation of water through the jackets around the cylinder and passes the hot water through the radiator where air absorbs heat from the water. internal engines are liquid-cooled using a mixture of chemical and water called antifreeze (coolant) and rust inhibitors to make it necessary to drain and refill the cooling system, It is therefore important that cooling system keep the various parts at a low temperature. According to (Debaun et al, 2007), he stated that the coolant should have cavitations and corrosion protection. It is necessary to prevent the coolant from freezing and this is usually done by adding a mixture of some compound such as ethylene glycol and water to depress the freezing point of the coolant at a ratio of 50%-50%. In order to optimize the engine cooling system, some technology will have to be presented for the whole cooling system (Ravi, 2014).

Merits of Liquid Cooling System;

- It has longer lifespan
- It operates quietly
- It is energy efficient
- There is no open space needed
- It is safe

Demerits of Liquid Cooling System;

- More maintenance is required

- It has complicated installation
- It is less efficient in humidity
- It has high cost
- It is not ideal for drought-stricken areas

Types of Liquid Cooling System

- Thermo-Syphon cooling system: This system works on the principles that hot water being lighter rises up and the cold water being heavier goes down. In this system the radiator is placed at a higher level than the engine for easy flow of water towards the engine. Heat is conducted to the water jackets from where it is taken away due to convention by the circulating water. As the water becomes hot, it rises to the top of the radiator. Cold water from the radiator takes place of the rising hot water and in this way a circulation of water is set up in the system which helps in keeping the engine at working temperature. This type of cooling system has its disadvantage;

- Circulation stops as the level of water falls below the top of the delivery pipe of the radiator.
- The rate of circulation is low.
- Circulation only starts when there is marked difference in temperature.

- Pump/forced circulation cooling system: This system makes use of a centrifugal pump to circulate water through the water jackets and radiator. The water flows from the lower portion of the radiator to the water jackets of the engine through the centrifugal pump. After the circulation, water comes back to the radiator. It loses it heat by the process of radiation.

- Direct or non-return circulation cooling system: This system is suitable for large installation and where plenty water is available. The water from a storage tank is directly supplied to the engine cylinder. The hot water is not cooled for reuse but simply discharged.
- Hopper cooling system: This system also works on the same principle as the thermo-syphon system. In this system, there is a hopper on a jacket containing water, which surrounds the engine cylinder. As soon as the water starts boiling, it is replaced by cold water. An engine fitted with this system cannot run for several hours without it being refilled with water.

Air Cooling System

It is only used in older cars or some modern motorcycles and they operate at higher, more efficient temperatures. In this system, the heat which is conducted to the outer parts of the engine is radiated and conducted away by the stream of air which is obtained from the atmosphere. They offer important advantage of not only eliminating the freezing and boiling of the coolant at extreme temperature but also corrosion damage to the cooling system. Air cooled engines provides more simplicity which gives benefit when it come to servicing and replacement of parts and are usually cheaper to maintain. It allows a flow of current through the parts from which heat is to be dissipated, which depends upon the surface area of metal in contact rate of air flow, a temperature difference between hot surface and air. Air-cooling is mostly tractors of less horsepower, motorcycle, scooters, small cars and small aircraft engines where the forward motion of the machine gives god velocity to cool the engine. In this system, individual cylinders are generally employed to provide ample cooling area by providing fins and a blower to provide air. Fan and shroud: all stationary air-cooled engines must have a fan or blowers of some type to

circulate a large volume of air over and around the cylinders. While the shroud when assembled will form a compartment around the engine so that cooling air is properly directed for effective cooling.

Merits of Air Cooling System;

- It is simpler in design and construction.
- Water jackets, radiators, water pumps, thermostat, pipes, hoses etc are eliminated.
- It is more compact.
- It is more reliable and less maintenance is required.
- There are no coolant leakages or problems.
- Coolant and antifreeze are not required.
- It can be used in cold climates.

Demerits of Air Cooling System;

- It is less efficient.
- It is used in airplanes, motorcycles and scooters where engines are exposed to air directly.
- More noisy operation.

Servicing of Engine Cooling System

For smooth and trouble-free servicing, the cooling system should be cleaned periodically to prevent accumulation of excessive rust and scale and to extend the life of the vehicle. The commercial cleaning compounds available must be carefully used in accordance to the manufacturers' specifications. The individual components which require servicing include the water pump, thermostat, hoses, fan, fan belt, radiator and pressure cap and a considerable amount

of rust and scale has being accumulated, it may not be possible that cleaning alone will be able to remove them but with special air pressure gases and refilling the engine coolant periodically. Doing so, there are numbers of additives in the freeze that help to prevent corrosion in the cooling system. Servicing of engine cooling systems comprises of three procedures;

- Pressure flushing: in this procedure, the air pressure is used to both agitate and circulate the water through the cooling system.
- Straight flushing: connect the lead-away hose to the water outlet connection on the engine. Insert the flushing gun in the hose attached to the water pump inlet connection. Turn on the water until the water passages are filled and the release the air in short blasts, allowing the water to fill the engine after such blasts.
- Reverse flushing: before making connections, the thermostat should be removed from the cooling system.

2.4 Emanating Technologies in Servicing Engine Lubricating Systems

All internal combustion engines are equipped with an internal lubricating system and so without lubrication, an engine is quickly overheated and its working parts seized due to excessive friction. Elakkiya and Anita, (2015) stated that lubrication is the process or technique employed to reduce the wear of one or both surface in close proximity. Lubrication is the process of reducing friction between moving parts, help in the transfer of heat and cool engine parts, clean the inside of the engine by removing contaminants and absorbs shock between moving parts to quiet engine operations by applying lubricants in between them. Okwelle, Beako, & Ajie (2017) opine that lubrication is the most vital singular factor in auto maintenance. Proper lubrication is the most important factor in machinery maintenance and without lubrication, there would be

wear down from friction, overheating Shahabuddiin, (2013). All moving parts must be adequately lubricated to assure maximum wear and long engine life. Anikit & Mohit (2016) sees it as a system that provides metered amount of lubricant to multiply location on a machine while the machine is operating. .similarly, Bonnick and Newbold (2011) stated that the lubricating system keeps friction and wear on the moving parts to a minimum, keeps the moving parts clean The engine lubrication system: minimize power loss by reducing the friction between the moving parts, reduce wear and tear of the moving parts, provides cooling effects to the hot engine parts, provides cushioning effects against vibrations caused by the engine, carries out the internal cleaning of the engines and helps pistons rings to seal against high-pressure gases in the cylinder according to Giri 2012, the primary purpose and function of lubrication system on engines is it reduce friction and wear and tear between two surfaces, it also act as a cooling effect after heat is been generated, it act as seal preventing the leakage of gases, and it keeps engine parts clean by removing dirt or carbon from inside the engine.), it reduce the noise created by moving parts, it minimize power loss due to friction. The lubrication system supplies the engine oil to various parts in the engine which are: the crankshaft main bearings, big end bearings, pistons pins and small end bushes, cylinder walls, piston rings, timing gears, camshaft and bearings, valves, tappets and push-rods, oil pumps parts, water pump bearings, in-line fuel injection pump bearings, turbocharger bearings (if fitted), vacuum pump bearings (if fitted), air-compressor piston and bearings (in commercial vehicles for air-brake

Lubrication system is a system that carries controlled amount of lubricants to multiple locations within an engine. Anikit & Mohit (2016) sees it as a system that provides metered amount of lubricant to multiply location on a machine while the machine is operating. .There are three types of lubricants: solid lubricants (Graphite, Mica, Talc powder), liquid lubricants (animal fat oil,

vegetable oil, mineral) and semi solids (heavy greases). Lubricants have properties which are graded according to their; viscosity, viscosity index, flash point and fire point, cloud point and pour point, oiliness and wettability, vitality and carbon residue. A good lubricant should have the following qualities Jayaseelan, (2014).;

- It should remain stable under changing temperature.
- It should have sufficient viscosity to keep the rubbing surface apart.
- It should keep lubricated pans clean.
- It should not corrode metallic surfaces.

Types of Lubrication System

According to Saif (2020), Lubrication system comprises of six types they include:

- Mist or Petroil Lubrication System:

In this system, it is commonly used in two-stroke petrol engines such as motorcycle and scooters. It is the simplest form and it does not have any separate part like an oil pump. The lubricating oil is added to the petrol itself during filling in the petro tank of the vehicle in a specific ratio. When fuel enters into the crank chambers, oil particles go down into the bearing surfaces, cylinder walls, piston pins e.t.c and lubricates them. If the engine is remains unused for a considerable amount of time, the lubricating oil separates off from petrol and starts clogging of passages in the carburetor resulting in the disadvantage of the system.

Merits

- Separate lubricating system is not required.
- Weight o engine is reduced by avoiding separate lubricating system.

- No maintenance cost is required.

Demerits

- More oil makes excess air in the exhaust.
- If oil is less than there is chance o seizure of the engine.

- Wet Sump Lubrication System:

In this system a big oil sump is provided at the base of the crankcase, from the sump oil is pumped to different parts of the engine.

- Splash Lubrication System**:**

In this system, the lubricating oil accumulates in an oil sump. A scooper or dipper is made in the lower part of the connecting rod. When the engine runs, the dipper dips in the oil once in every revolution of the crankshaft and causes the oil to splash on the cylinder walls. His action affects the engine walls, piston rings, crankshaft bearings and large end bearings.

- Pressure Lubrication System**:**

In this system, lubrication is done with the help of pressure pump or feed which is submerged in the pump, with the aid of pressure pump after filtration, oil is forced under pressure to different parts of the engine through oil tubes from the bearing oil floats to the connecting rod through oil holes between connecting rod and cam shaft then this oil flows to piston pin through oil holes and sprayed over piston, piston rings, cylinder valve and other part.

- Semi- pressure Lubrication System:

In this system, it is the combination of a splash and pressure working principles whereby the splash system is not sufficient when bearing loads are higher hence lubricating oil under pressure is supplied by oil pump to main and crankshaft bearings, the oil pump also supplies oil under pressure to pipes which is directs a stream of oil against the dippers (scoop) on the connecting rod bearing cups and other parts are lubricated by splash oil by scoop.

- Dry Sump Lubrication System:

In dry sump, extra oil is stored in a tank outside the engine rather than oil pan. The lubrication oil is passed through the pipes using scavenging pumps and after lubrication; the oil is again collected by special connecting sections and passed to eat exchanger for cooling. The scavenging pump has greater capacity than oil feed pumps and it is placed externally to sump.

Merits of dry sump lubrication system

- Improvements to vehicle handling and stability.
- Improved engine reliability due to consistent oil pressure.
- Increased oil capacity by using a larger external reservoir.
- Having the pumps external to the engine makes them easier to maintain and replace.

Demerits of dry sump lubrication system

- It add cost, complexity and weight
- The extra pumps and lines requires additional oil an maintenance
- Inadequate upper valve train

- The large external reservoir and pumps can be tricky to position around the engine and within the engine bay due to their size.

Components parts of Engine Lubrication Systems

According to Bonnick and Newbold (2011), Lubrication system comprises of several components or parts they are:

- Oil Pan / Sump:

It is just a bowl-shaped reservoir that stores the engine oil and circulates it within the engine. It sits below the crankcase and store the engine oil when the engine is not running. It is located at the bottom of the engine in order to collect the store engine oil. The oil returns to the sump by pressure/gravity when the engine is not in use. The sump guard absorbs the hit from the uneven roads and protects the sump from any damage.

- Engine oil filter:

It is used in the engine lubricating system in most motor vehicles to filter out the dirt or grit particles from the oil. There are three basic types of oil filter element configurations;

- The cartridge type: It contains a filtering element placed in a metallic casing. The casing has an inlet and outlet oil pump enters casing through the filtering element, which takes up all the impurities. The filtered oil then comes out from the casing and goes to the oil gallery. The filtering element may be cleaned when clogged or replaced when not conditioned to be cleaned properly.
- The edge type oil filter: It contains a number of the disc in the casing through which the oil passes. The alternate disc is mounted over a spindle and the disc, between these, are

fixed to a separate square rod. The clearance between the two discs is only a few thousand of a centimeter. When the oil flows through this small clearance, it leaves impurities on the disc peripheries by operating the central spindle periodically the impurities so collected on the disc are removed.

- The centrifugal type oil filter: It contains a stationary casing, rotor casing, central spindle and tubes with jets. The impure oil enters the hollow central spindle and through whole around its periphery, the oil goes to the rotor casing. From the rotor casing the oil goes in the tubes, at the ends of which the jets are attached. The oil passes through these jets under pressure, he reaction of which provides the motion to the rotor casing so it begins to rotate. The oil from the jets impinges on the walls of the stationary casing under heavy pressure, where the impurities are retained and the clean oil falls below, which is taken for use, the filter walls are cleaned periodically.

➢ Oil Pickup and Strainer:

The oil pickup is simply a tube which extends from the oil pump to the bottom of the oil pan. While the oil strainer, It is simply a wire mesh screen; it is attached to the inlet of the oil pump so that the oil going in the oil pump is free from impurities. It retains the dirt or grit of the oil. Usually, a floating strainer is installed which is hinged to the oil pump inlet. It is adjusted that it floats at the oil surface and the impurities remain at the bottom of the crankcase. By doing only a small amount of impurities goes to the strainer screen and hence it has less chances of being clogged. A by-pass is also kept in the strainer to allow oil to pass when the screen is completely clogged.

- Oil Pump:

It is a device which helps to circulate the lubricant oil to all the moving parts inside the engine. These parts includes: crankshaft, camshaft bearings and valve lifters. It is generally located at the bottom of the crankshaft, close to the oil sump. It supplies oil to oil filter which filters and sends it onward. The oil then reaches to different moving parts of the engines through the oil galleries. . The oil pumps consist of the rotary and gear pump. If the oil pump gets choked or blocked by small particles, it can cause severe damages to the engine or even complete seizure of the engine and for these to be avoided, it is necessary to change the engine oil and filter at regular intervals.

- Pressure Relief Valve:

This valve allows excess oil flow generated by the engine oil pump to return to the sump. The oil pump must be able to generate sufficient pressure at engine idle speed to keep all bearings supplied with oil; this means that at high engine speed, the pump is capable of producing more pressure than the lubrication system and seals can deal with. The pressure relief valve can open and allow excess oil to run directly back to the sump. There are three types which are –the disc type, ball type and the plunger type.

- Oil Galleries:

They are interconnected passages which supplies the oil to the remotest parts of the engine. It consists of big and small passages drilled inside the cylinder block. The bigger passages connect to the smaller passages and supply the engine oil up to the cylinder head and overhead camshafts. It supply oil to the crankshafts, crankshaft bearings and camshaft bearings through drilled holes and valve lifters/tappets and so it is essential that engine oil quickly gets to the moving parts of the engine for better performance and longer engine life.

- Oil Cooler:

It is a device which works just like a radiator. It cools down the engine oil which becomes very hot. Oil cooler transfers the heat from the engine oil to the engine coolant through its fins. It helps to maintain the temperature of the engine oil and keeps its viscosity under control and it retains its lubricant quality thereby preventing the engine from overheating and wear and tear. However, most vehicles uses oil cooler system for better engine performance.

- Oil Level Indicator:

The level of oil in the crankcase is checked by a dipstick. It is a long stick with a handle at one end for holding. It is graduated with marks full, half and empty. To check the oil level, the stick is dipped into the crankcase and taken out. The oil sticks on the stick which shows the oil leve; in the crankcase. The oil should be below a critical mark. Before starting a vehicle particularly a long journey, the oil level must be checked.

- Oil Pressure Gauge:

It is mounted on the instrument panels in all cars equipped with a pressure lubricating system to indicate the oil pressure in the engine. It consists of two types: Pressure expansion type and electric type (Balancing coil type and bimetal-thermostat type).

- Pressure expansion type oil pressure gauge:

  It contains hollow bourdon (curve) tube that is fastened at one end and free at the other end. The oil pressure is applied though an oil line from the engine which causes the tube to straightened out. This movement is transmitted to a needle by linkage and the gears

from the end of the tube. The needle moves across the face of the dial indicating the oil pressure.

- Electric type- balancing coil type oil pressure gauge:

  It consists of two separate units/ the engine unit and the indicating unit. The engine unit consists of a moving contact that moves over a resistance according to the varying oil pressure against a diaphragm. As the pressure increases, the diaphragm moves inward by which the contact moves along the resistance so that more resistance is placed in the circuit between the engine and the indicating unit. This reduces the amount of current lowing in the circuits. While the indicating unit consists of two coils that balance the movement of the pointer on a scale, in a manner similar to the electrically operated fuel gauge.

-Electric type- bimetal-thermostat type oil pressure gauge:

The metal thermostat type oil pressure indicator is similar to the bimetal thermostat fuel gauge. It consists of an engine and a dash unit. The oil pressure on a diaphragm distorts the engine unit thermostat blade, and this distortion produces a similar distortion in the dash unit thermostat blade, causing the oil pressure to indicate on the dial.

- Oil Pressure Indicating Light:

In many motor vehicles, the engine oil pressure is indicated by a warning light. The light comes when the ignition switch is turned on and the oil pressure is low. The circuit user four-stage diaphragm switch which operates a warning a lamp according to the oil pressure required for different engine feeds. Each of these four-stages is brought into a circuit with the warning lamp

by a selector switch operated in conjunction with the speed-o-meter. In this way, the warning lights up only when the oil pressure falls below the value.

Servicing of Engine Lubricating System

The following are the care and maintenance (servicing) for good engine lubrication system;

- Connections, piping, valves and pressure gauge should be checked regularly.
- A good design of oil circulation system should be chosen.
- Oil should be cleaned regularly and after specified period of use and oil filters should be replaced by new filters.
- Correct oil grades of lubricants ensures long and trouble free service.
- Oil should be maintained at desired level in the oil chamber.
- Oil should be changed regularly after specific period of time.
- Precautions should be taken to keep the oil free from dust and water.

2.5 Summary of reviewed related literature

The review of related literature has given the researcher an understanding under this study from its various contributions which has given an effective and efficient results on the emanating technologies needed by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating system was carried out covering these sub-headings: Motor vehicle mechanics and its objectives, curriculum of motor vehicle mechanic, emanating technologies in servicing Engine Cooling System, emanating technologies in servicing Engine Lubricating System, summary of reviewed related literature. However, it has been observed that craftsmen possesses limited tools and equipments or no mechanical knowhow and none of the emerging technical skills on how to perform well in automobile industries and as such pose a threat on the servicing

mechanism on motor vehicle cooling and lubricating systems. The review has shown that Motor Vehicle Mechanic curricula programs should be reviewed for effective and efficient training and enables its recipient the various opportunities to be gainfully employed at the end of the course or after completing one or more employable skills.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Design of the Study

A descriptive survey research design was used for the study. A descriptive survey research design according to McCombes (2019), is a framework that includes the methods and procedures to collect, analyze and interpret as much data and information as possible. Therefore, it concerns with collecting of data from a sample that has been selected, description of events as they are considered suitable without manipulation of any kind.

3.2 Area of the Study

The study was conducted in the following areas in Minna metropolis: mechanic village in Kpankungu, mechanic village in Chanchaga, mechanic village in Sabon Gari, mechanic village in Bosso, mechanic village in Tunga, mechanic village in Barikin Sale, mechanic village in Tayi village, mechanic village in Tudun Fulani and mechanic village in Shango.

3.3 Population of the Study

The targeted population for the study was 170 respondents comprising of 100 Highly Experienced and 70 Moderately Experienced Motor Vehicle Mechanic Craftsmen in Minna metropolis of Niger State.

3.4 Sample and Sampling Technique

Since the total population is of manageable size, no sampling technique was used for the study, Hence the entire population was used for the study.

3.5 Instrument for Data Collection

The instruments used for the collection of data for the study was structured questionnaire administered to the craftsmen and clients in Minna metropolis titled Engine Cooling and Lubricating System Technical Competencies Questionnaire (ECLSTCQ). It was divided in into three sections (A,B & C), section A dealt with highly experienced motor vehicle craftsmen and moderately experienced motor vehicle mechanic craftsmen as regards to the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system ,section B dealt with determining the challenges encountered by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating systems and section C dealt with the strategies that could improve the technical competencies of motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system by motor vehicle mechanic craftsmen in Minna metropolis of Niger State. Section A was structured on a four-point rating scale option of Highly Needed (HN), Needed (N), Moderately Needed (MN) and Not Needed (NN), sections B and C was structured on a four-point rating scale option of Strongly Agreed (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with a corresponding value of 4, 3, 2 and 1.

3.6 Validation of the Instrument

The questionnaire was validated by three (3) experts from the Departments of Industrial and Technology Education, Federal University of Technology Minna for their correction and effectiveness of the instrument.

3.7 Reliability of the instrument

To establish the reliability of the instruments, a preliminary was carried out on 4 highly experienced motor vehicle craftsmen and 4 moderately experienced motor vehicle mechanic craftsmen who are outside the study area but have similar characteristics to the studied area. This is in accordance with the opinion of Uzoagulu (2011) that the reliability of an instrument is the consistency of the instrument in measuring whatever it purports to measure. The questionnaire was administered, retrieved an analyzed using Statistical Package for Social Sciences (SPSS) to determine the reliability coefficient.

3.8 Administration of the Instrument

The instrument was administered personally by the researcher to all highly experienced Motor Vehicle Mechanic Craftsmen and moderately experienced Motor Vehicle Mechanic Craftsmen in Minna metropolis of Niger State and all questionnaires were returned after completion.

3. 9 Method of Data Analysis

The data collected was analyzed using mean and standard deviation, while t-test was used to analyze the null hypothesis published for the study, at 0.05 level of significant. The computation of the mean and standard deviation was carried out.

$$\text{Mean} = \frac{\sum FX}{N}$$

Where

Σ = Summation of values

X = Nominal values of option

$\overline{X}$ = Mean of each item

N = Number of respondents of items

F = Frequency of respondents of each option

The Standard Deviation (SD) for each group of respondent was calculated using the formula

$$S.D = \sqrt{\frac{\Sigma f(x-x)^2}{N}}$$

Where

S.D = Standard Deviation

$\bar{x}$ = Mean of each item

$\bar{x}^2$ = Grand mean of all the items

Σ = Summation of values

3.10Decision Rule

The four point rating scale that was employed to analyze the data collected for the study are:

Strongly Agree (SA) = 4

Agree (A) = 3

Disagree (D) = 2

Strongly Disagree (SD) = 1

To determine the acceptance level of the respondents, a mean of 2.50 was selected as the decision point. Any item with a mean response above 2.50 will be considered agreed while items below 2.50 will be considered disagreed. The acceptance level for the four point rating scale use to analyze the response as shown below:

$$\frac{4+3+2+1}{4} = \frac{10}{4} = 2.50$$

CHAPTER FOUR

4.0 PRESENTATION AND ANALYSIS OF DATA

4.1 Result

This chapter analyzed the data that has been collected with respect to the research question and hypothesis carried out for this study. A total number of one hundred and seventy (170) were administered to the respondents in all the Motor Vehicle Mechanics in Minna metropolis and all the questionnaires were filled and returned by both the craftsmen and clients. The data analysis for the research questions and hypothesis tested are arranged and was presented respectively.

Research question 1

What are the technical competencies needed by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems.

Table 4.1.1: Mean response of the respondent on what are the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system.

N1= 100, N2=70

S/NO	ITEMS	X_1	X_2	X_T	Remark
1.	Carry out oil pressure alarm indication test	2.60	2.55	2.58	Highly Needed
2.	Verify power supply to oil pressure alarm sensor	2.71	2.89	2.80	Highly Needed
3.	Replace oil pressure alarm sensor	2.76	2.69	2.73	Highly Needed
4.	Replace defective oil pump	2.81	2.71	2.76	Highly Needed
5.	Select appropriate tools for the repairing of lubrication system	2.77	2.64	2.71	Highly Needed
6.	Replace defective oil filters	2.88	2.67	2.78	Highly Needed
7.	Check for leaks in the cooling system	2.80	2.60	2.70	Highly Needed
8.	Check radiator filler neck	2.82	2.57	2.70	Highly Needed

9.	Test radiator for leaks	2.79	2.50	2.65	Highly Needed
10	Replace damaged radiator belts	2.76	2.64	2.60	Highly Needed
11	Inspect antifreeze mixtures and coolants	2.87	2.53	2.70	Highly Needed
12.	Select appropriate tools for repairing cooling system	2.84	2.51	2.58	Highly Needed

Key: X_1=mean of highly experienced motor vehicle mechanic craftsmen, X_2=mean of moderately experienced motor vehicle mechanic craftsmen, X_T= average mean of the highly experienced and moderately experience motor vehicle mechanic craftsmen N=Number of respondents

Analysis in table 1 showed that both highly experienced and moderately experienced agreed that all the variables highlighted are the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system. This is evident in the grand mean score of 2.78 for highly experienced and 2.59 for moderately experienced, which are both greater than 2.50 which is the acceptable mean value.

Research question 2:

What are the ways to determine the challenges encountered by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems?

Table 4.1.2: Mean response of the respondents on what are the ways of determining the challenges encountered by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system.

N1=100, N2=70

S/NO	ITEMS	X_1	X_2	X_T	Remark
1.	Lack of adequate knowledge of engine cooling and lubricating system	2.60	2.54	2.57	Highly Needed
2.	Lack of modern equipments and tools to diagnosis faults	2.50	2.861	2.56	Highly Needed
3.	Most vehicle mechanics are lazy	2.77	2.84	2.81	Highly Needed
4.	Lack of knowledge of the internet to check for modern approaches to repair and maintenance	2.92	2.76	2.84	Highly Needed
5.	High cost of spare parts of engine cooling and lubrication systems on modern vehicles	2.77	2.64	2.60	Highly Needed
6.	Modern vehicles comes with more complexity	2.86	2.67	2.77	Highly Needed
7.	Poor work environment	2.91	2.69	2.80	Highly Needed
8.	Lack of proper tools for repair and maintenance	2.90	2.81	2.86	Highly Needed

Key: X_1=mean of highly experienced motor vehicle mechanic craftsmen, X_2=mean of moderately experienced motor vehicle mechanic craftsmen, X_T= average mean of the highly experienced and moderately experience motor vehicle mechanic craftsmen, N=Number of respondents

Analysis in table 2 showed that both highly experienced and moderately experienced agreed that all the variables highlighted are the challenges encountered by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating systems. This is evident in the grand mean score of 2.78 for highly experienced and 2.67 for moderately experienced, which are both greater than 2.50 which is the acceptable mean value.

Research question 3:

What are the strategies that could be adopted to improve the technical competencies of Motor Vehicle Craftsmen in the servicing of engine cooling and lubricating system?

Table 4.1.3: mean response of the respondents on the strategies that could be adopted to improve the technical competencies of Motor Vehicle Craftsmen in the servicing of engine cooling and lubricating system?

S/NO	ITEMS	X_1	X_2	X_T	Remark
1.	Supervision of practical activities of moderately experienced motor vehicle mechanic craftsmen by highly experienced motor vehicle mechanic craftsmen	2.80	2.81	2. 81	Agreed
2.	Provision of adequate tools for repair and maintenance of engine cooling and lubricating system	2.85	2.77	2.81	Agreed
3.	In-service training of highly experienced motor vehicle mechanic craftsmen on engine cooling and lubricating system	2.83	2.69	2.79	Agreed
4.	Retraining of both highly and moderately experienced motor vehicle mechanic craftsmen on the usage of modern technological tools for diagnosing faults related to engine cooling and lubricating system	2.87	2.83	2.85	Agreed
5.	Use of the internet to check for modern ways of approach to repairs and maintenance of engine cooling and lubricating system	2.85	2.64	2.75	Agreed
6.	Providing proper work environment for the repairing and maintenance of engine cooling and lubricating system	2.90	2.87	2.89	Agreed
7.	Provision of modern equipment for diagnosing faults	2.75	2.69	2.72	Agreed
8.	In service training on the usage of detectors and test equipments newly introduced due to latest innovations	2.77	2.91	2.84	Agreed
9.	Introduction to modern method of troubleshooting and routine maintenance	2.78	2.69	2.74	Agreed

10	Specializing on a particular in area of automobile, e.g. cooling system or lubrication system	2.95	2.61	2.78	Agreed

Key: X_1=mean of highly experienced motor vehicle mechanic craftsmen, X_2=mean of moderately experienced motor vehicle mechanic craftsmen, X_T= average mean of the highly experienced and moderately experience motor vehicle mechanic craftsmen, N=Number of respondents

Analysis in table 3 showed that both highly experienced and moderately experienced agreed that all the variables highlighted are the strategies that could be adopted to improve the technical competencies of motor vehicle craftsmen in the servicing of engine cooling and lubricating system. This is evident in the grand mean score of 2.84 for highly experienced and 2.75 for moderately experienced, which are both greater than 2.50 which is the acceptable mean value.

HYPOTHESIS TESTING

H_{01}: T-test analysis on what are the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system.

S/NO	ITEMS	X_1	SD_1	X_2	SD_2	T-test	Remark
1.	Carry out oil pressure alarm indication test	2.60	0.50	2.55	0.28	0.14	NS
2.	Verify power supply to oil pressure alarm sensor	2.71	0.97	2.89	0.38	0.15	NS
3.	Replace oil pressure alarm sensor	2.76	0.28	2.69	0.71	0.08	NS
4.	Replace defective oil pump	2.81	0.41	2.71	0.84	0.10	NS
5.	Select appropriate tools for the repairing of lubrication system	2.77	0.14	2.64	0.35	0.25	NS
6.	Replace defective oil filters	2.88	0.39	2.67	0.57	0.19	NS
7.	Check for leaks in the cooling system	2.80	0.28	2.60	0.49	0.54	NS
8.	Check radiator filler neck	2.82	0.56	2.57	0.14	0.68	NS
9.	Test radiator for leaks	2.79	0.14	2.50	0.63	0.39	NS

10	Replace damaged radiator belts	2.76	0.28	2.44	1.05	0.29	NS
11	Inspect antifreeze mixtures and coolants	2.87	1.25	2.53	0.42	0.92	NS
12.	Select appropriate tools for repairing cooling system	2.84	0.83	2.31	0.97	0.43	NS

Keys: SD1= Standard Deviation of highly experienced motor vehicle mechanic craftsmen, SD2= Standard Deviation of moderately experienced motor vehicle mechanic craftsmen, t=test, NS= Not Significant, value of t= 1.96, level of significant=0.05.

The analysis in table 4 shows that there is no significant difference between the mean response of highly experienced and moderately experienced on the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system because all items were less than the t-critical of 1.96 which means the null hypothesis was accepted at 0.05 level of confidence. Thus, there is no significant difference between the mean response of highly experienced and moderately experienced on the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system.

H_{02}: the T-test analysis on what are the strategies that could be adopted to improve the technical competencies of Motor Vehicle Craftsmen in the servicing of engine cooling and lubricating system?

S/NO	ITEMS	X_1	SD_1	X_2	SD_2	T-test	Remark
1.	Supervision of practical activities of moderately experienced motor vehicle mechanic craftsmen by highly experienced motor vehicle mechanic craftsmen	2.80	0.28	2.81	0.62	0.10	NS
2.	Provision of adequate tools for repair and maintenance of engine cooling and lubricating system	2.85	0.17	2.77	0.20	0.18	NS
3.	In-service training of highly experienced motor vehicle mechanic craftsmen on engine cooling and	2.83	0.17	2.69	0.62	0.16	NS

	lubricating system						
4.	Retraining of both highly and moderately experienced motor vehicle mechanic craftsmen on the usage of modern technological tools for diagnosing faults related to engine cooling and lubricating system	2.87	0.51	2.83	0.83	0.14	NS
5.	Use of the internet to check for modern ways of approach to repairs and maintenance of engine cooling and lubricating system	2.85	0.17	2.64	0.14	0.22	NS
6.	Providing proper work environment for the repairing and maintenance of engine cooling and lubricating system	2.90	0.21	2.87	0.24	0.12	NS
7.	Provision of modern equipment for diagnosing faults	2.75	0.32	2.69	0.62	0.05	NS
8.	In service training on the usage of detectors and test equipments newly introduced due to latest innovations	2.77	0.18	2.91	0.66	0.16	NS
9.	Introduction to modern method of troubleshooting and routine maintenance	2.78	0.19	2.69	0.62	0.08	NS
10	Specializing on a particular in area of automobile, e.g. cooling system or lubrication system	2.95	0.36	2.61	0.45	0.56	NS

Keys: SD1= Standard Deviation of highly experienced motor vehicle mechanic craftsmen, SD2= Standard Deviation of moderately experienced motor vehicle mechanic craftsmen, t=test, NS= Not Significant, value of t= 1.96, level of significant=0.05.

The analysis in table 5 shows that there is no significant difference between the mean response of highly experienced and moderately experienced on the vehicle mechanic craftsmen and moderately experienced motor vehicle mechanic craftsmen on the strategies that could be

adopted to improve the technical competencies of motor vehicle craftsmen in the servicing of engine cooling and lubricating system because all items were less than the t-critical of 1.96 which means the null hypothesis was accepted at 0.05 level of confidence. Thus, there is no significant difference between the mean responses of highly experienced and moderately experienced on the strategies that could be adopted to improve the technical competencies of motor vehicle craftsmen in the servicing of engine cooling and lubricating system.

4.2 Findings of the study

1. The findings on table 1 show the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system. The findings revealed that all items are highly needed.

2. The findings on table 2 show the challenges encountered by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system. The findings revealed that all items agreed.

3. The findings on table 3 show the strategies that could be adopted to improve the technical competencies of motor vehicle craftsmen in the servicing of engine cooling and lubricating system. The finding revealed that all items agreed.

4.2 Discussion of finding

The study with respect to the first research question revealed that the level of technical competencies needed by motor vehicle mechanic craftsmen in servicing engine cooling and lubricating system are being undertaken to cover major and common technical and practical servicing techniques in the automobile industries and as such, various processes such as carrying

out oil pressure alarm indication test, verifying power supply to pressure alarm sensor, checking for leaks in the cooling system, replacing radiator filler neck, replacing defective oil filters, inspecting antifreeze mixtures and coolants, selecting the various appropriate tools of operation on the engine cooling and lubricating system are necessary for performing desired servicing outcome and so, therefore there is need to ensure that the technical competencies should be included in motor vehicle mechanic curriculum and technical colleges to acquire the necessary skills and to ensure that automobile employers, employees, teachers and students benefit from structured and desired practical performance carried out on modern vehicles. It is therefore incumbent on the motor vehicle mechanic craftsmen to keep updating and upgrading their technical competencies and servicing practices in order to enable them to continually develop the capacity to inspect and service modern automotive vehicles without being kicked out to technological advancements. The finding is in agreement with Olaitan and Ikeh(2005) which state that for a competent workforce and progress in automobile business, employable skills, technical skills, basic tools and facilities are of great importance to prospecting motor vehicle mechanic in servicing engine cooling and lubricating system.

From table 2, the study also revealed the challenges encountered by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems. Most motor vehicle mechanics lack the adequate knowledge on cooling and lubricating system components and methods of various servicing performance practices making it difficult for them. A good number of motor vehicle mechanic craftsmen lack the various equipments and tools for diagnosing and servicing modern vehicles. Some motor vehicle mechanic craftsmen are lazy to carry out their jobs and practices and they lack the technical knowhow on the usage of the internet to check for modern approaches on servicing. High cost of modern vehicle spare parts and poor work

environments also pose a great challenge and are part of what motor vehicle mechanic craftsmen encounters on daily basis in the automobile industry.

From table 3, the study also reveals the strategies that would be adopted by motor vehicle mechanic craftsmen in servicing of engine cooling and lubricating system. Most highly experienced motor vehicle craftsmen should be able to supervise the performance and servicing techniques and practices of moderately experienced motor vehicle mechanic craftsmen, provision of adequate modern tools and equipments for the repair and servicing of modern vehicles. A formal interview reveal that most motor vehicle mechanic craftsmen undergo in-service training and retraining on the usage of modern technological tools for diagnosing faults, servicing of engine cooling and lubricating systems and so much more. Due to complex specialty, most motor vehicle mechanic craftsmen specialize in a particular area to ease automobile servicing ambiguity.

Hypothesis 1shows that there is no significant difference between the response of highly experienced motor vehicle mechanic craftsmen and moderately experienced motor vehicle mechanic craftsmen on the technical competencies needed by motor vehicle mechanic craftsmen in the servicing of engine cooling and lubricating system. Therefore, they all agreed to the technical competencies needed by motor vehicle mechanic craftsmen are highly needed.

Hypothesis 2 shows that there is no significant difference between the response of highly experienced motor vehicle mechanic craftsmen and moderately experienced motor vehicle mechanic craftsmen on the strategies that could be adopted to improve the technical competencies of motor vehicle craftsmen in the servicing of engine cooling and lubricating

system. Therefore, the respondents agreed that all the items should be adopted to improve the technical competencies needed.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of the study

The study was carried out on the technical competencies needed by motor vehicle mechanic craftsmen in servicing of engine cooling and lubricating system. Chapter one discussed more on few automobile histories, motor vehicle mechanic craftsmen, engine cooling systems and engine lubrication system. The statement of the study described the motor vehicle mechanic craftsmen performance, level of knowledge and skills are being attained. The aim and objectives of the study, significance of the study, research question was formulated to guide the study.

The review of related literature was under the following subheadings

- Motor vehicle mechanics and its objectives
- Curriculum of motor vehicle mechanic
- Emanating technologies in servicing Engine Cooling System.
- Emanating technologies in servicing Engine Lubricating System.
- Summary of reviewed related literature.

However, the data for this study were collected by means of questionnaire and each items were based on three formulated research questions which was administered to the respondents. The statistical tool used for analyzing the data is frequency, means, standard deviation and t-test.

5.2 implication of the study

Modern vehicles systems such as the cooling and lubrication systems which is stated and updated into curriculum contents programmes, will remain insignificant in the automobile technology and as such find it hard to achieve a standard technical competence required and so pose a threat to gainful employment, acquiring of technical skills, transportation, economic and technological growth of the nation. The implication of this study will affect the servicing of modern vehicles by motor vehicle mechanic craftsmen due to lack of adequate tools, vehicle spare parts being expensive, inadequate technological knowhow, lack of appropriate relevant skills in their respective specialties and so all this contributes to the various challenges encountered and as such hinders the technical competences of craftsmen. In addition the findings of this study will also have great effect on motor vehicle teachers and student in the sense that most programmes on modern vehicle will not be accreditated and as such will hinder the transfer of knowledge and technical performance practical skills in improving the competences needed. Therefore, the challenges that the solutions to these various problems pose to those involved is an implication of this study.

5.3 Contribution to knowledge

1. Motor vehicle mechanic craftsmen should be updated on the technological advancements of modern vehicles to facilitate better technical knowhow and performance practices.

2. Motor vehicle mechanic craftsmen, teachers and students should be educated on the importance of servicing techniques and practices to be carried out on modern vehicles.

3. To educate motor vehicle mechanic craftsmen on the various strategies that would help improve the numerous technical competences needed in servicing modern engine cooling and lubricating systems.

5.4 Conclusion

Based on the analysis of the findings, the technical competences of motor vehicle mechanic craftsmen have been assessed. Automotive vehicles should be maintained and serviced appropriately and adequately. Currently, most motor vehicle mechanic craftsmen are faced with numerous challenges and as such, automotive mechanics must be able to understand how the modern technologies functions. If majority of motor vehicle mechanic craftsmen fails to adapt, upgrade and update to technological advancement and changes, there will be lose of competent mechanic craftsmen in few years to come because of the inability to adapt to technological changes to modern day methods. as cooling and lubrication parts plays a vital role in the operation of the automobile, various targeted practices should be carried out to avoid damages to the overall performance of the automobile and at the same time vehicles should be serviced on daily basis which can reduce effectively the probability of faults and improve the service life of the internal system of the automobile and also, modern tools and equipment of lubrication and cooling systems should be utilized for effective teaching and learning in technical colleges.

Therefore, it could be concluded that the performance technical practices of the automotive services could be improved by giving automobile craftsmen the needed professional training and adequate resources to finance modern tools, equipments and logistics.

5.5 Recommendation

Based on the findings and conclusion gotten from this study, the following recommendations are made to assist the automotive service garages to operate at a competitive advantage.

1. The National Automotive Council (NAC) should create means of sensitizing the craftsmen in order to maintain standards and recommends effective ways of carrying out vehicle servicing works.

2. The government should assist by giving subsidy to motor vehicle mechanic craftsmen in bringing more benefits in terms of employment generation to lower masses thereby contributing to the economic growth of the country.

3. There should be training and in-service training programmes available on the internet to enable mechanics to become masters and proficient in their auto service practices as education and training is a lifelong process.

5.6 Suggestion for further research

The following suggestions are made for further research:

1. Emerging technology needed by motor vehicle mechanics towards automobile servicing and repairs.

2. Assessment of performance practice of motor vehicle mechanic craftsmen needed in the servicing of modern vehicles.

3. Evaluation of competent skills needed by technical college students towards the utilization of automobile technologies.

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

AUTO-MECHANICS TECHNOLOGY

BUILDING TECHNOLOGY

ELECTRICAL/ELECTRONIC TECHNOLOGY

METAL WORK TECHNOLOGY

WOOD WORK TECHNOLOGY

DATE_____

YOUR REF:_____

OUR REF:_____

LETTER OF INTRODUCTION FOR CANDIDATE CONDUCTING RESEARCH WORK

----------with Matric No.----------

is an Undergraduate student of the Department of Industrial and Technology Education of the Federal University of Technology, Minna. He/She is currently undertaken a research work titled:

_____

_____

_____

It would be highly appreciate if you could supply him/her with the necessary information he/she may require from you. All information supplied will be used solely for this research work and will be treated as confidential.

Thank you so much for your cooperation.

A.M. HASSAN

Project Coordinator

QUESTIONAIRE

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGYEDUCATION

SECTION A

QUESTIONAIRE BASED ON THE COMPETENCIES NEEDED BY MOTOR VEHICLE MECHANIC CRAFTSMEN IN THE SERVICING OF ENGINE COOLING AND LUBRICATION SYSTEM IN MINNA METROPOLIS OF NIGER STATE.

INTRODUCTION: please kindly complete the questionnaire with all sincerity in the column that represents your perception on the above topic.

The questionnaire is for research purpose and your view will be treated with confidentially.

Highly Experienced Motor Vehicle Mechanic Craftsmen ☐

Moderately Experienced Motor Vehicle Mechanic Craftsmen ☐

Guide on how to represent on the questionnaire: use the following rating scale to indicate your opinion by ticking the phase that best describes your level of agreement on the item.

Highly Needed	(HN)	=	4 points
Needed	(N)	=	3 points
Moderately Needed	(MN)	=	2 Points
Not Needed	(NN)	=	1 point

Strongly Agrree	(SA)	-	4 points
Agree	(A)	-	3 points
Disagree	(D)	-	2 points
Strongly Disagree	(SD)	-	1point

SECTION B

RESEARCH QUESTION 1

What are the ways to find out the technical competencies needed by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems?

S/N	ITEMS	HN 4	N 3	MN 2	NN 1
1	Carry out oil pressure alarm indication test				
2	Verify power supply to all pressure alarm sensor				
3	Replace oil pressure alarm sensor				
4	Visually inspect the oil pressure alarm for damage part				
5	Replace wearing moving parts with new ones				
6	Check and replace defective oil pump				
7	Verify the operation of the lubrication system				
8	Select appropriate tools for the repairing of lubrication system				
9	Check for external leaks in cooling system				
10	Check for internal leaks in the cooling system				
11	Check radiator filler neck				
12	Inspect radiator and radiator belt				

SECTION C

RESEARCH QUESTION 2

What are the ways to determine the challenges encounter by Motor Vehicle Mechanic Craftsmen in the servicing of engine cooling and lubricating systems?

S/N	ITEMS	HN 4	N 3	MN 2	NN 1
1	Lacks of adequate knowledge of engine cooling and lubrication systems on modern vehicles				
2	Lack of modern equipments and tools to diagnosis faults				
3	Most vehicle mechanic vehicle craftsmen are lazy				
4	Lack of knowledge of the usage of the internet to check for modern approaches to repair and maintenance				
5	High cost of spare parts of engine cooing and lubricating systems on modern vehicles				
6	Modern vehicles comes with more complexity				
7	Poor work environments				
8	Lack of proper tools for repair and maintenance				

SECTION D

RESEARCH QUESTION 3

What are the interval strategies that will improve the technical competencies of Motor Vehicle Craftsmen in the servicing of engine cooling and lubricating system?

S/N	ITEMS	SA 4	A 3	D 2	SD 1
1	Supervision of practical activities of moderately experience motor vehicle mechanic craftsmen by highly experienced motor vehicle mechanic craftsmen				
2	Provision of adequate tools for repair and maintenance of engine cooling and lubricating system				
3	In-service training of highly experience motor mechanic craftsmen engine cooling and lubricating system				
4	Retraining of highly experience motor vehicle mechanic craftsmen on the usage o modern technological tools for diagnosing faults related to engine cooling and lubricating system				
5	Use of the internet to check for modern ways of approach to repairs and maintenance of engine cooling and lubricating system				
6	Providing proper work environment for repairing and maintenance of engine cooling and lubricating system				
7	Provision of modern equipment for diagnosing faults				

8	In Service training on the usage of detectors and test equipments newly introduced due to latest innovations				
9	Introduction of modern method of trouble shooting and routine maintenance				
10	Specializing on a particular area of automobile, e.g. cooling system or lubrication system				