# ASSESSMENT OF THE JOB PERFORMANCE OF ROAD-SIDE MECHANICS IN THE MAINTENANCE OF MODERN AUTOMOBILE VEHICLES IN MINNA METROPOLIS

**BY**

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**2007/1/28546BT**

**DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA**

**OCTOBER, 2012**

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**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, SCHOOL OF SCIENCE AND SCIENCE EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF BACHELOR OF TECHNOLOGY (B.TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION.**

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# CERTIFICATION

I OGUGUO UCHECHUKWU CHIKODILI with matriculation number 2007/1/28546BT an undergraduate 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 Diploma or Degree of this or any other university.

..... .....

**Name** **Sign-date**

## APPROVAL PAGE

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

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| **Supervisor** | **Sign - date** |
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| **Head of Department** | **Sign - date** |
| ..... | ..... |
| **External Supervisor** | **Sign - date** |

# DEDICATION

With profound joy in my heart, I dedicate this project to God Almighty for His loving kindness and His Faithfulness towards my life and for making this project a reality today. Blessed be the name of the Lord.

## ACKNOWLEDGEMENTS

I humbly appreciate the Almighty God for His Loving kindness, His Divine and constant guidance in my life to the end of this chapter of my life, as it has deemed Him fit to see me through the successful completion of my studies in the university.I profoundly acknowledge my project Supervisor, Dr. J. F. Maigida for his immense support towards the successful completion of this project. Special thanks go to my external supervisor Dr. T.C Ogbuanyi for her advice and support. I also want to acknowledge Dr. Raymond Emmanuel for spending time going through the project work for errors. Special thanks also goes to my internal reader Mallam Abdukadir Mohammed for also taking his time going through the research work for errors. Sincere gratitude also goes to the project coordinator, Mr. Saba Moses, the Grand Patron Industrial and Technology Education Department Prof. G.D. Momo H, Prof. K.A. Salami, H.O.D Industrial and Technology Education Department Dr. E.J. Ohize and all my wonderful lecturers in the department of Industrial and Technology Education who has contributed greatly to my life. I pray that God Almighty blesses the works of your hands and replenish your strength, wisdom, vision, knowledge and understanding throughout your life. Amen. Finally, my sincere appreciation goes to all my family members, friends, well wishers and every person who appreciate the life in Industrial and Technology Education

## ABSTRACT

This study assessed the Job Satisfaction and Performance of Road-Side Mechanics in the Maintenance of Modern Automobile Vehicle in Minna Metropolis. Three research questions and two null hypotheses where formulated to guide the study. A survey research design was adopted for the study. A total of 145 respondents consisting 95 road-side automobile mechanics and 50 vehicle owners randomly selected, was used as a population for the study. A 33 items questionnaire developed by the researcher and validated by 3 experts from Industrial and Technology Education Department, Federal University of Technology, Minna was used for data collection. Mean and standard deviation were the statistical tools used to analyze the data collected from the research question. While t-test statistics was used to test the null hypotheses at 0.05 level of significant. The findings among others revealed that road-side auto mechanics lack the high tech skills needed to repair today's cars, auto mechanics repair shop lack the basic diagnostic (on-board and off-board) equipment needed for diagnosis, service and repair of modern automobiles, road-side auto mechanics need continuous training and retraining in automobile maintenance to keep pace with rapid changes in automobile industry. Based on the findings it was recommended that road-side auto mechanics should acquire the high-tech skills needed for effective maintenance of today's automobile, Auto Technicians should equip their workshop with modern diagnostic equipment in order to meet the challenges of maintaining modern cars, the automobile industries should regularly organize training programmes for road-side auto mechanics on changes or innovations in automobiles and based on the findings it was also concluded that the introduction of electronic sensor, circuits and computers in automobiles makes it difficult, complex and more sophisticated for diagnosis, service and repair, road-side auto mechanics lack the knowledge and skills to use diagnostic (on-board and off-board) equipment for diagnosis, service and repairs of modern cars and the orthodox skills of auto mechanics have been rendered valueless by the emergence of computerized technology in modern automobiles.

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# CHAPTER 1

# INTRODUCTION

## Background of the Study

Assessment is the systematic method of gathering, analyzing and using information from various sources about an administrative unit, using measured outcomes, in order to improve student support services and student learning. Assessment, used in this work relates to measuring critical administrative processes in order to gather data that provides information about how the institution is meeting stakeholders' needs and expectations Nichols (2008). Hendrikz (1986) viewed assessment of an educational programme as the use of reliable and valid ways of discovering how far a programme is successful and where it falls short of its goals. Akinseinde (1988) in his view defined assessment as a process of determining the value or worth of a thing. Akinseide added that assessment involves obtaining information for use in judging the worth of a programme, product, procedure or objective. Andrews (1976) defined assessment as a process of calculating, judging or appraising value, quality or ability, in terms of relative or absolute measurement. This value according to Andrews could be less than or more than. Ughamadu (1992) in his opinion defined assessment as a process of ascertaining the decision to be made, selecting related information, collecting and analyzing information in order to report summary data useful to decision makers in selecting among alternatives. Researchers have put a considerable amount of effort into assessment of job satisfaction and performance and found out that a happy worker is a successful worker. Although this sounds like a very appealing idea, the results of empirical literature are too mixed to support the hypothesis that job satisfaction leads to better performance or even that there is a reliable positive correlation between these two variables. On the other hand, some researchers argued that the results are equally inconclusive with respect to the hypothesis that

there is no such relationship. As a result of this ambiguity, this relationship continues to stimulate research and re-examination of previous attempts.

Job performance is a commonly used, yet poorly defined concept in industrial and organizational psychology, the branch of psychology which deals with the workplace and Human Recourse Management (HRM). Job performance commonly refers a situation in which a person performs a given job either well or not using the necessary and relevant updated performance skills Bono and Judge (2003). Despite the confusion over how it should be exactly defined, performance is an extremely important criterion that relates to organizational outcomes and success. One view, associated with the early human relation's approach, is that satisfaction leads to performance. An alternative view is that performance leads to satisfaction. However, a variety of studies suggest that research has found only a limited relationship between satisfaction and work output and offer scant comfort to those seeking to confirm that a satisfied worker is also a productive one.

Road-side automobile mechanics, according to Miami (2009), an automobile Mechanic (or car mechanic in British English and motor mechanic in Australian English) is a mechanic who specializes in automobile maintenance, repair, and sometimes modification. An automobile mechanic may be knowledgeable in working on all parts of a variety of car makes or may specialize either in a specific area or in a specific make of car. For instance, he/she may specialize on Toyota, BMW, Ford, Acura, Chrysler, Chevrolet, Mercedes Benz, Nissan, Opel, Peugeot, Volkswagen etc. In repairing cars, their main role is to diagnose the problem accurately and quickly. They often have to quote prices for their customers before commencing work or after partial disassembly for inspection. The mechanic uses both electronic means of gathering data as well as their senses.

Vehicle is said to be a means of transportation that move people, animals or things

from one place to another ( Fales and Kuetemeyer, 1997). The automobile with its ease of use and freedom of direction has become a mainstay of modern life transportation. Although Nicolas Joseph Cugnot is often credited with building the first self- propelled mechanical vehicle or automobile in about 1769, by adapting an existing horse- drawn vehicle, this claim is disputed by earlier technologies, who doubt Cugnot's three- wheeler ever ran or was stable. What is not in doubt is that Richard Trevithick built and demonstrated his Puffing Devil road locomotive in 1801, believed by many to be the first demonstration of a steam-powered road vehicle, although it was unable to maintain sufficient steam pressure for long periods, and would have been of little practical use. There has been tremendous change in modem car technology. Automobiles have changed more in the last decade than in the previous 60 years (Duffy, 1985). They now use sophisticated computer technology, advanced wiring, intricatecircuitry and complex engineering. New cars and trucks are far more complex than they used to be (New York State Automobile Dealers Association, 2006).

Maintenance of modern cars has become a major challenge to the service mechanics. Apparently, it is upon this (maintenance) that the life span of the automobile depends to a great extent. According to Narayan (2004), maintenance is a set of preventive, corrective or breakdown rectification activities. Olaitan, Nwachukwu, Igbo, Onyemachi and Ekong (1999) defined maintenance as taking specific approved steps and precautions to care for a piece of equipment, machinery or facility and ensure that it attains its maximum self-life. Maintenance is taking specific steps and precautions to care for an automobile to ensure that it attains its maximum intended life.

One can no longer rely on amateur knowledge or trial and error to repair the cars of today. According to Schwaller (1988), probably one of the most important careers in the automobile industry is that of the service technician. This person is expected to diagnose service and completely repair any problem on the automobile. He/she must also be able to

solve problems associated with the automobile.

According to Okorie (2000), if Nigeria is to benefit fully from technology, which Niger State is not an exception, people have to be trained for jobs in the changing world of work. The service technicians who are mostly responsible for effective maintenance of the automobile are trained formally in technical colleges and informally through apprenticeship system. UNESCO (1985) expressed concern about the quality of vocational education programmes, as well as the gross inadequacy of human resources in technical schools in Africa which has likely hampered the goals of assessing the job satisfaction and job performance of Road-side automobile mechanic for effective maintenance of modern vehicle in Minna Niger State.

**Statement of the Problem**

For road-side mechanic to effectively service and repair today's high technology cars, professional automotive mechanics must have training and experience in diverse range of subjects including mechanical engineering, electrical engineering, electronics, chemistry, physics, metallurgy, plumbing, safety engineering, welding and metal fabricating, lubricating and hazardous waste handling, New York State Automobile Dealers Association NYSADA (2006) posited that, mechanics must have an extensive knowledge of mechanical electronic and computer technology, and this must be updated constantly to meet up with rapid changes.

Unfortunately, it is sad to note that these road-side mechanics seems not to possess the high tech skills in maintaining today’s car. This may be as a result of low competency of road-side auto mechanics, lack of modern equipment in their workshops, inadequate training and re-training of road side mechanics on the use of modern equipment etc. The problem of this study is therefore to assess the job performance of road-side mechanics in the maintenance of modern vehicles in Minna Metropolis.

**Purpose of the study**

The purpose of the study is to assess the Job performance of road-side auto mechanics in maintaining modern vehicles in Minna metropolis. Specifically, the study sought to:

1. Determine the skill performance of road side mechanics in diagnosing fault in Modern Automobile.
2. Identify the modern equipment needed by auto mechanics to achieve job satisfaction for vehicle users.
3. Identify strategies that will be adopted to meet the need for job performance of auto practitioners.

**Significance of the study**

The findings of this study will be of benefit to Vehic1e owners, automobile road-side mechanics, transporters/fleet operators, teachers and student of automobile Technology programme at all levels, car dealer, road safety department, and society at large will also benefit from the findings of this study.

The findings of this study will be of benefit to Vehic1e owners in reduction automobile accidents resulting from mechanics' amateur knowledge or trial and error method used for automobile repairs. Vehicle owners will be exposed to basic problems envisaged in motor vehicles and this will make them to be an informed consumer. This study will help eliminate fear in vehicle owner when going to roadside mechanics for repair and thus regain confidence in the job automobile roadside mechanic. The results of this research will help to improve the job performance skills, knowledge, competence and confidence of automobile roadside mechanics. Automobile roadside mechanic will have opportunities to acquire skills, knowledge, appreciation and interest to repair modern vehicles that are faulty.

The findings of this study will be of immense benefits to transporters/fleet operators if properly implemented. If transporters are informed about basic vehicle maintenance as they work with automobile roadside mechanic, they will maximize profit and continue to remain in business. The findings of this study will enable the car dealers not to run out of competent

mechanics that will handle the maintenance and servicing of their cars. The findings of this study will benefit the society at large to enjoy improved safety, improved productivity and reduction in economic waste. The findings of this study if adequately implemented will reduce the rate of unemployment due to self-employment, improved manpower development as well as keeping pace with global technological change.

**Research Questions**

The following research questions were formulated to guide the study;

1. What are the skill performances required by road side mechanics in the diagnosing fault in modern automobiles?
2. What are the modern equipments needed by auto mechanics to achieve job satisfaction for vehicle users?
3. What are the strategies that will be adopted to meet the need for job performance of auto practitioners?

**Hypotheses**

The following hypotheses relative to the study will be tested at 0.05 level of significance:

**$H0_1$:** There was no significant difference between the mean responses of Automobile road-side mechanics and vehicle users on the skill performance required in diagnosing fault in modern automobile.

**$H0_2$:** There was no significant difference between the mean responses of Automobile road-side mechanics and vehicle users on the modern equipments needed by auto mechanics to achieve job satisfaction for vehicle users.

**Scope of the Study**

The study is delimited to the skill performances required by road-side mechanics in diagnosing fault in modern automobiles, the modern equipments needed by auto mechanics to achieve job satisfaction for vehicle users and the strategies that will be adopted to meet the need for job performance of auto practitioners.

# CHAPTER II

# REVIEW OF RELATED LITERATURE

The review of related literature was carried out under the following sub-headings:

- Concepts of assessment and assessment in education
- The Automobile and its historical background
- Innovations in Automobile Industry
- Concept of Job performance
- Maintenance in Automobile Technology
- Review of Related Empirical Studies
- Summary of Reviewed Literature

## Concept of Assessment and Assessment in education

Assessment is an accountability tool to improve the quality of job effectiveness and performance Keelin (2008).: Hendrikz (1986) viewed assessment of an educational programme as the use of reliable and valid ways of discovering how far it is successful and where it falls short of its goals. Hendrikz emphasized on assessing the success of teaching programmes and methods used. Akinseinde (1988) in his view defined assessment as a process of determining the value or worth of a thing. Akinseide added that assessment involves obtaining information for use in judging the worth of a programme, product, procedure or objective. Andrews (1976) defined assessment as a process of calculating, judging or appraising value, quality or ability, in terms of relative or absolute measurement. This value according to Andrews could be less than or more than. Ughamadu (1992) in his opinion defined assessment as a process of ascertaining the decision to be made, selecting

related information, collecting and analyzing information in order to report summary data useful to decision makers in selecting among alternatives.

Assessment is also a systematic method of gathering, analyzing and using information from various sources about an administrative unit, using measured outcomes, in order to improve student support services and student learning. Assessment, as it is addressed in this manual, relates to measuring critical administrative processes in order to gather data that provides information about how the institution is meeting stakeholders' needs and expectations Nichols (2008).

The methods of assessment can be either direct or indirect assessment methods Student Voice (2010). Direct methods, such as rubrics, gather data through observation or artifacts requiring students to display their knowledge, behavior, or thought process. Indirect methods, such as questionnaires, ask participants to reflect upon or rate their knowledge, behavior, or thought process.

Much recent literature on assessment in Higher Education (HE) gives strong support to the use of both peer and self-assessment (Boud 1995, Brown and Knight 1994, Gibbs 2001, Brown & Pendlebury 1997, Brown and Glasner 1998, Brown & Dove 1990). For Boud, self-assessment is a transferable skill and is a principal part of work experience.

Peer assessment is the assessment of the work of others with equal status and usually has an element of mutuality. Underpinning a peer-assessment process is giving and receiving feedback from which continued reflection and perhaps dialogue may continue. Browna and Pendlebury (1997) draw a distinction between 'peer assessment' and 'peer marking', the later being the process by which someone makes an estimate of another's work, and also of 'peer feedback marking' which involves students deriving criteria, developing a peer assessment form, providing anonymous feedback and assigning a global mark. In the context of this study, the term "peer-assessment" is more closely allied to Brown definition of "peer feedback marking".

The use of peer and self-assessment carries a number of perceived advantages:

- Students have more ownership of the assessment process (i.e. it is not just being "done" to them);
- It can involve students in devising and understanding assessment criteria and in making judgements;
- It encourages formative assessment - learning through feedback;
- It encourages the reflective student (autonomous learner);
- It has validity - it measures what it is supposed to measure;
- It can emphasise the process not just the product;
- It is expected in working situations;
- It encourages intrinsic rather than extrinsic motivation;
- It challenges the role of the tutor as the sole arbiter of assessment.

Toohey (1996) argues that self (and peer) assessment by students is generally trustworthy provided that the criteria have been made explicit, students have had the opportunity to practice assessment skills, the rating instruments are simple and a second marker is used to moderate the assessment. In essence, if a student understands the learning requirement, the process is managed appropriately with opportunities for giving and receiving feedback, then it is likely to be a positive and constructive process for all concerned.

**Formative assessment**

Formative assessment is a range of formal and informal assessment procedures employed by teachers during the learning process in order to modify teaching and learning activities to improve student attainment Crooks (2001). It typically involves qualitative feedback (rather than scores) for both student and teacher that focuses on the details of content and performance Huhta (2010). It is commonly contrasted with summative assessment, which seeks to monitor educational outcomes, often for purposes of external accountability Shepard

and Lorrie (2005).

Noting in a widely cited review that the term formative assessment "does not have a tightly defined and widely accepted meaning", Black and Wiliam operate an umbrella definition of "all those activities undertaken by teachers, and/or by students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged Black, Paul; Wiliam, Dylan (1998). Along similar lines, Cowie and Bell (1999) define formative assessment as the process used by teachers and students to recognise and respond to student learning in order to enhance that learning, during the learning". Nicol and Macfarlane (2005), who emphasise the role students can play in producing formative assessments state that "formative assessment aids learning by generating feedback information that is of benefit to students and to teachers. Feedback on performance, in class or on assignments, enables students to restructure their understanding/skills and build more powerful ideas and capabilities.

Formative assessment is typically contrasted with summative assessment. The former supports teachers and students in decision-making during educational and learning processes, while the latter occurs at the end of a learning unit and determines if the content being taught was retained. Ainsworth (2006).

Formative assessment is not distinguished by the format of assessment, but by how the information is used. The same test may act as either formative or summative. However, some methods of assessment are better suited to one or the other purpose. Wiliam and Dylan (2006).

**Summative assessment**

Summative refers to the assessment of the learning and summarizes the development of learners at a particular time. After a period of work, e.g. a unit for two weeks, the learner sits for a test and then the teacher marks the test and assigns a score. The test aims to summarize learning up to that point. The test may also be used for diagnostic assessment to identify any weaknesses and then build on that using formative assessment.

Summative assessment is commonly used to refer to assessment of educational faculty by their respective supervisor. It is imposed onto the faculty member, and uniformly applied, with the object of measuring all teachers on the same criteria to determine the level of their performance. It is meant to meet the school or district's needs for teacher accountability and looks to provide remediation for sub-standard performance and also provides grounds for dismissal if necessary. The evaluation usually takes the shape of a form, and consists of check lists and occasionally narratives. Areas evaluated include classroom climate, instruction, professionalism, and planning and preparation. Glickman & Gordon (2009). Summative assessment is characterized as assessment of learning and is contrasted with formative assessment, which is assessment for learning.

It provides information on the product's efficacy (its ability to do what it was designed to do). For example, did the learners learn what they were supposed to learn after using the instructional module. In a sense, it does not bother to assess "how they did," but more importantly, by looking at how the learners performed, it provides information as to whether the product teaches what it is supposed to teac

**The steps in the assessment process**

One of the first steps in the assessment process is the development of statements of what worker should know, be able to do, and value. These statements should be based upon the departmental mission statement, an integral part of the departmental program. The remainder of the assessment process involves the development of an assessment plan that includes:

- The selection or design of appropriate assessment methods;
- Implementing the assessment methods and gathering data on how well students have achieved the expected learning outcomes;
- Examining, sharing, and acting on assessment findings to improve student learning.

- Examining the assessment process itself—assessing assessment.

**Roles of Assessment**

Assessment has three (3) roles or functions namely

- Role of Gate keeping.
- Role of ensuring accountability.
- Role of instructional diagnosis.

The role with the longest history is that of gate keeping ( National Commission on Testing and public policy, 1990) in which assessment determine who is granted a privilege such as admission or graduation.

The role of accountability Darling and Ascher (1991) in which assessment is used to decide if job are performed well. The third role is that of instructional diagnosis Bradby and Rossi (1996) in which assessment is used to find out what auto mechanic do and do not know and what to do about it. These roles have not simply replaced each other rather, additional requirements have gradually been added to the expectations held for external assessment. In a given assessment program, these roles may overlap. The purpose to be met in each role, however, need to be clearly distinguished, as program design and procedures need to be compatible with their purposes.

The extent to which educational programmes are being achieved can be determined through the process of assessment

**The Automobile and its historical background**

Several Italians recorded designs for wind driven vehicles. The first was Guido da Vigevano in 1335.It was a windmill type drive to gears and thus to wheels. Vaturio designed a similar vehicle which was also never built. Later Leonardo da Vinci designed a clockwork driven tricycle with tiller steering and a differential mechanism between the rear wheels.

A Catholic priest named Father Ferdinand Verbiest has been said to have built a steam, powered vehicle for the Chinese Emperor Chien Lung in about 1678. There is no informatics about the vehicle, only the event. Since Thomas Newcomen didn't build his first steam engine until 1712 we can guess that this was possibly a model vehicle powered by a mechanism like Hero's steam engine, a spinning wheel with jets on the periphery. Newcomen's engine had a cylinder and a piston and was the first of this kind, and it used steam as a condensing agent to form a vacuum and with an overhead walking beam, pull on a rod to lift water. It was an enormous thing and was strictly stationary. The steam was not under pressure, just an open boiler piped to the cylinder. It used the same vacuum principle that Thomas Savery had patented to lift water directly with the vacuum, which would have limited his pump to less than 32 feet of lift. Newcomen's lift would have only been limited by the length of the rod and the strength of the valve at the bottom. Somehow Newcomen was not able to separate his invention from that of Savery and had to pay for Savery's rights. In 1765 James Watt developed the first pressurized steam engine which proved to be much more efficient and compact that the Newcomen engine.

The first vehicle to move under its own power for which there is a record was designed by Nicholas Joseph Cugnot and constructed by M. Brezin in 1769. A replica of this vehicle is on display at the Conservatoire des Arts etMetiers, in Paris. I believe that the Smithsonian Museum in Washington D. C. also has a large (half size ) scale model. A second unit was built in 1770 which weighed 8000 pounds and had a top speed on 2 miles per hour and on the cobble stone streets of Paris this was probably as fast as anyone wanted to go it. The picture shows the first model on its first drive around Paris were it hit and knocked down a stone wall. It also had a tendency to tip over frontward unless it was counterweighted with a canon in the rear. the purpose of the vehicle was to haul canons around town.

The early steam powered vehicles were so heavy that they were only practical on a perfectly flat surface as strong as iron. A road thus made out of iron rails became the norm

for the next hundred and twenty five years. The vehicles got bigger and heavier and more powerful and as such they were eventually capable of pulling a train of many cars filled with freight and passengers.

However, many attempts were being made in England by the 1830's to develop a practical vehicle that didn't need rails. A series of accidents and propaganda from the established railroads caused a flurry of restrictive legislation to be passed and the development of the automobile bypassed England. Several commercial vehicles were built but they were more like trains without tracks.

The development of the internal combustion engine had to wait until a fuel was available to combust internally. Gunpowder was tried but didn't work out. Gunpowder carburetors are still hard to find. The first gas really did use gas. They used coal gas generated by heating coal in a pressure vessel or boiler. A Frenchman named Etienne Lenoir patented the first practical gas engine in Paris in 1860 and drove a car based on the design from Paris to Joinville in 1862. His one-half horse power engine had a bore of 5 inches arid a 24 inch stroke. It was big and heavy and turned 100 rpm. Lenoir died broke in 1900. Lenoir had a separate mechanism to compress the gas before combustion.

In 1862, Alphonse Bear de Rochas figured out how to compress the gas in the same cylinder in which it was to burn, which is the way we still do it. This process of bringing the gas into the cylinder, compressing it, combusting the compressed mixture, then exhausting it is known as the Otto cycle, or four cycle engine. Lenoir claimed to have run the car on benzene and his drawings show an electric spark ignition. If so, then his vehicle was the first to run on petroleum based fuel, or petrol, or what we call gas, short for gasoline. Siegfried Marcus, of Mecklenburg, built a can in 1868 and showed one at the Vienna Exhibition of 1873. His later car was called the Strassenwagen had about 3/4 horse power at 500 rpm. It ran on crude wooden wheels with iron rims and stopped by pressing wooden blocks against the iron rims, but it had a clutch, a differential and a magneto ignition. One of the four cars

which Marcus built is in the Vienna Technical Museum and can still be driven under its own power.

In 1876, Nokolaus Otto patented the Otto cycle engine, de Rochas had neglected to do so, and this later became the basis for Daimler and Benz breaking the Otto patent by claiming prior art from de Rochas. In 1885, is of Gottllieb Daimler's workshop in Bad Cannstatt where he built the wooden motorcycle shown. Daimler's son Paul rode this motorcycle from Cannstatt to Unterturkheim and back on November 10, 1885.

Daimler used a hot tube ignition system to get his engine speed up to 1000 rpm. The previous August, Karl Benz had already driven his light, tubular framed tricycle around the Neckar valley, only 60 miles from where Daimler lived and worked. They never met. Frau Berta Benz took Karl's car one night and made the first long car trip to see her mother, traveling 62 miles from Mannheim to Pforzheim in 1888. Also in August 1888, William Steinway, owner of Steinway & Sons piano factory, talked to Daimler about US manufacturing right and by September had a deal. By 1891 the Daimler Motor Company, owned by Steinway, was producing petrol engines for tramway cars, carriages, quadricycles, fire engines and boats in a plant in Hartford, CT. Steam cars had been built in America since before the Civil War but the early one were like miniature locomotives. In 1871, Dr. J. W. Carhart, professor of physics at Wisconsin State University, and the J. 1. Case Company built a working steam car. It was practical enough to inspire the State of Wisconsin to offer a $10,000 prize to the winner of a 200 mile race in 1878. The 200 mile race had seven entries, or which two showed up for the race. One car was sponsored by the city of Green Bay and the other by the city of Oshkosh. The Green Bay car was the fastest but broke down and the Oshkosh car finished with an average speed of 6 mph. From this time until the end of the century, nearly every community in America had a mad scientist working on a steam car. Many old news papers tell stories about the trials and failures of these would be inventors.By 1890 Ransom

E. aids had built his second steam powered car. One was sold to a buyer in India, but the ship it was on was lost at sea.

**Innovation in Automobile Industry**

Innovation may also be seen as new or recent technology. It is a new way of doing something. Amitabh (2009) defined innovation as the exploration of new ideas leading to the creation of a new product, process or service. He further stated that it is not just the innovation of new ideas that is important, but it is actually bringing it to market, putting it into practice and exploiting it in a manner that leads to new technological transformation and management re-construction. Innovation also means exploiting new technology and employing out of the box thinking to generate new value and to bring about significant changes in the society.

Schumpeter (1984) distinguished between invention and innovation; new or recent technology as an idea manifest and innovation as an idea applied successfully in practice. He further reveals that there are different types of innovation such as “product innovation” that entails the introduction of a new product or a service that is new or considerably improved, “process innovation” comprising the implementation of new or significant enhanced production or delivery method, “supply chain innovation” in which innovation transform the sourcing of input products from the market and the delivery of output products to customers and “marketing innovation” which results in the evolution of new methods of marketing with enhancements in product design or packaging, its promotion or among others. Innovation leads to wealth creation. Peter (2009) reveals that while innovation typically adds value, innovation may also have a negative or destructive effect as new developments clear away or change old organizational forms and practices. He further emphasized that organizations that do not innovate effectively may be destroyed by those that do. An organization that is not able to innovate faces decline and extinction. Innovation involves a high risk of costly

research and development (R and D) that can eat up shareholders return. Research and developments is an innovative research phenomena which occur when research combined with practical applications lead to improved processes and new products in an industry (Wikipedia, 2009). Eric (2008) identifies two sources of innovations; “manufacture innovation” where a person or company’s innovation is in order to sell the innovation and “end user innovation” where a person or company develops an innovation for their sole use because existing products do not meet their needs. He further stressed that competition is the determinant of innovation, productivity and wealth creation. Innovation, new or recent technology therefore involves the introduction of new products, new services, new processes, new business systems and new methods of management which have a significant positive impact on productivity and growth of an organization. For instance, Larson (2000) reveals that the world’s largest automobile manufacturer "General Motors (GM)" has me deep into innovation to broaden its original equipment manufacturer (OEM) alliances by acquiring other smaller companies and increasing its technical alliance with Honda and Toyota auto manufacturer. The GM's heritage in innovation includes first speedometer, first electric self starter, first fully automatic transmission, collapsible steering column, catalytic converter, first crash test dummies, first child restraint system, first computerized crash test, first integrated chassis control system and advanced virtual reality technology.

Competitive pressures have forced most automobile companies to increase their focus on innovation, the automobile industry has significantly expanded the electronics and computer content on the vehicle, with applications ranging from power train controls for improved fuel economy and reduced emissions, to enhanced safety systems and chassis controls to on board communication system (Eric, 2008). The precision and super fast speed of computers has made major advancements possible in auto engineering. Today, electronics comprises more than 25% of each automobile and that figure is expected to grow to more than 30% by 2012

(Wikipedia, 2009). Automotive computers and electronics takes care of everything from airbag safety systems and anti lock braking systems to fuel efficiency, clean auto technology and global positioning system (GPS) with the present trends in innovations in motor vehicle, it is obvious that it is only those auto mechanics that posses specialized skill that will survive in the auto mechanic job in the long term. The product life cycle for automobiles continues to shorten due to competitive market pressures. This IS so because competitive market forces have caused automakers to dramatically redesign car models every four: to five years. New technological developments have led to unique and innovative designs for future automobiles. Alternative fuel technologies such as electric hybrids and fuel cell cars have received considerable attention; International trade commission (ITC, 2002); Wikipedia (2009) reveals that the "big three" automakers in united states of America (USA) such as General Motors, Ford and Chrysler and other automakers like Honda and Toyota have gradually began to manufacture hybrid vehicles. Hybrid vehicles combine two or more sources of power, which are able to operate using a rechargeable battery and gasoline. It has to be noted that the Japanese biggest automaker Toyota, is one of the auto industries leaders in hybrid vehicle research and production with the introduction of its previous model. Salami (2007) pointed out that ford motor company has invested a lot in research and development (R and D) to produce more alternative fuel vehicles and these involved:

- Developing a hybrid vehicle which will switch between gasoline and electric power and will achieve fuel economy.
- Developing fuel cell vehicle that will run on hydrogen and produce only water as a byproduct.
- Developing more fuel efficient and cleaner diesel powered engines.
- Introducing many advanced safety technologies in their products such as personal safety, system to protect front seat occupants during frontal clashes.

Recently many automobiles are increasingly relying on more advanced electronics, computer and wireless communication systems to assist drivers and enhance safety. These technologies replace mechanical systems that power, steer and break the vehicle. For instance, general motors' (GM) has introduced the autonomy concept model which uses hydrogen fuel cell technology that powers electric motors in each wheel. The vehicle uses a chassis and replaceable body; allowing greater flexibility and freedom in designing the interior. The vehicle operates using sophisticated computer and electronic systems. Voice activation is another technology being developed for use in vehicles. Voice activation systems operate internal climate controls, open doors and respond to navigational request by the driver. New development in the automobile electronic and communications technology is vehicle sensor technology. A sensor technology uses radar or laser technology to control systems that detect vehicle in front which then automatically slowdown the vehicle (Salami, 2007).

Mandell (1986) commented that to be prepared to cope with changes technology brings, computer literacy must be emphasized in training centers. He believed strongly that computers play important roles in our life and it has proven to be true because there is hardly any area of the society that have not been affected by this technology. Such areas may include manufacturing, construction, production and automobile service industry to mention a few. They have fully embraced the use of computer as a means of carrying out their various activities.

Adeniba (1996) drew our attention to the dynamic nature of computer technology and stated that, a nation that will exist in this technology age must not operate below a particular level of computer literacy and usage. Therefore our, work force must be exposed to the use of computer, in order to meet the challenges at stake. No technological improvement will reject the use of computer education. Adeyemo (1995) stated that we are training children that will later be absorbed into society that have already moved ahead of them and if we fail

to do our work in the area of innovation i.e., computer technology, we will end up creating a lot of problems for technicians of tomorrow. The said problem is for technicians and the society at large. In the absence of required work skills, technician's skills are obsolete and unemployed. This unhealthy situation compelled Ukpongson (1997) to lament that unemployment breed poverty; poverty gives birth to frustration, frustration produces restlessness which in turn leads to maladjustment and committing of criminal offenses and other related vices. These put master craftsmen on their toes to bread craftsmen that are equal to the task to avoid these social vices. Gomwalk (1990) emphasized that this lack of coordination has often resulted into wrong approach to the innovation and acquisition of technology appropriate to our state of development and need of society. Obviously this coordination can be achieved if necessary satisfaction in terms of work ethics and incentives are given to master craftsmen or master trainers. The satisfaction according to technology, trainers among all is recognition of trainer to vocation. Government should relief their suffering by given them incentives and loan. This will help them expand their business and probably provide adequate accommodation for the trainees.

According to Nryston (1977), it is believed that innovation is a key element to success in any enterprise. In technology education there are numerous reasons why innovation is necessary to meet the need which is realization that technology education must in some measures contribute to the preparation of young people's life in a society, increasingly pervaded by technology feats by way of using multi diagnostics tool to identify results in engine and correct it. At early age of youth, it is always easy and obvious for skills to be acquired and turn out youth with increased initiative of technological advancement. A recent example is the antilock brake system (ABS), with its wheel speed sensors and hydraulic actuators, these components can be used by other system such as traction and vehicles stability control, follow on cruise control and even speedometer drive. If no antilock system, most automakers would consider using speed sensors on all wheels which would have hinder the triggering of

antilock braking system (ABS). The global technological advancement and economic competitiveness seem to be more, if not most practical in the automobile industry. This is revealed by the recent trends in the automobile industry.

Among the most pronounced developments and challenges is the "Hybrid" vehicle Currently research and development is centred on hybrid vehicles that use both electric power and internal combustion. A hybrid vehicle, as revealed by Wikipedia (2006) uses multiple propulsion systems to provide motive power. This most commonly refers to gasoline-electric hybrid vehicles, which uses gasoline (petrol) to power the internal combustion engines, and electric batteries to power the electric motors.

Modern mass-produced hybrids, such as the Toyota Prius, recharge their batteries by capturing kinetic energy via regenerate braking. As well, when cruising or idling, some of the output of the combustion engine is fed to a generator (merely the electric motor(s) running in generator mode), which produces electricity to charge the batteries. Nearly all hybrids still require gasoline as their sole fuel.

For 2007 Lexus is offering a hybrid version of their sport Sedan GS450h with "well in excess of 300hp". The 2007 Camry hybrid has been announced and is slated to launch in late spring as a 2007 model, which will be built in Kentucky, U.S.A. (Wikipedia, 2006). General motors, BMW and Daimler Chrysler are working together on a so-called Two-Model Hybrid System, which is a full hybrid plus additional efficiency improvements. The technology, as stated in Wikipedia, will be released in 2008 on the Chevrolet Tahoe Hybrid.

There are many types of hybrids, differentiated by how the electric and fuelled halves of the power train connect, and at what times each portion is in operation. Two major categories are series hybrids and parallel hybrids, though parallel are most common today, Wikipedia disclosed. In a series design, the internal combustion engine is not directly connected to the drive train at all, but powers electrical generator portions, which can be combined in some paralleled hybrid designs.

Parallel systems, which are most common at present, connect both the electrical and internal combustion systems to the mechanical transmission. They are sub-categorized depending on how balanced the different proportions are at providing motive power.

A full hybrid, sometimes called a strong hybrid, is a vehicle that can run on just the engine, just the batteries, or a combination of both. The Prius and escape hybrids are examples of this. Toyota brand name for this technology is Hybrid Synergy Drive. Assist Hybrids use engine for primary power, with a torque boosting electric motor also connected to a largely conventional power train. The electric motor is essentially a very large starter motor, which operates not when the engine needs to be turned over, but also when the drive "steps on the gas" and requires extra power. Example of this type is Mazda's e-4Wd system.

Mild hybrids are essential conventional vehicles with oversized starter motors, allowing the engine to be turned off when the car is coasting, braking, or stopped, yet restart quickly and cleanly. A major example is the 2005 Chevrolet Silverado hybrid, a full size pickup truck (Wikipedia, 2006).

Petroleum (from which gasoline is refined) is an expensive and increasingl~ limited source. As a result, there has been a strong motivation to create more fuel-efficient engines (Robert and Soman, 1993). The biggest threat to automobiles is the declining supply of oil, which does not completely stop car usage but makes it significantly more expensive. Beginning of 2006 a gallon of gas costs approximately 6 US dollars in Germany and other European countries (Wikipedia, 2006). If no cheap solution can be found in the relative near future individual mobility might suffer a major setback, Wikipedia observed.

Research and development efforts in alternative forms of power focus on developing fuel cells, alternative forms of combustion and even the stored energy of compressed air. Some fuel cell-powered vehicles currently in, development, as revealed by Wikipedia, use some hybrid-like technology to stove auxiliary energy. Robert and Soman (1993) revealed that solar-powered cars are being developed. They also revealed that, the electric car of the future

is still being pursued. Ideally, they explained, this car would be capable of rapid acceleration, moderately long trips, and quick charge-ups.

There is at present a strong effort to develop electronic navigation systems for automobiles. Its designers explain that it would conserve fuel, among other things, by minimizing the number of times drivers loose their way and roam around looking for a landmark. Soman and Swernofsky revealed that, when fully implemented, drivers will simply request information on the shortest route. People are aware that automobile exhaust emissions pollute the atmosphere. The problem seems to be worsening. Since this problem continues to concern people, it will continue to be addressed in the future, Robert and Soman disclosed.

In order to limit deaths, there has been a push for self-driving automobiles. A current and powerful invention was Extra Sensory Perception (ESP) by Bosch and many followers that reduces deaths by 30% and is recommended by many lawmakers and carmakers to be a standard feature in all cars sold in the European Union (EU). ESP recognizes dangerous situations and corrects and driver's input for a short moment to stabilize the car (Wikipedia, 2006). Looking at automotive technology, some areas appear to have the most need of development. For example, both the rubber tyres and the batteries currently used by most car seem rather antiquated when compared to, say, modern-day engine and traction-control systems. These are like jets with cardboard wings with hard drives respectively, Wikipedia revealed. While slow moving cars can control their wheels via ESP reasonably well, fast moving vehicles like a Bugadtti Veyron need a special tyre check-up before approaching 400km/h. Also, the existing batteries are barely fit to handle the cars electronic but are far off from the ability to store enough energy for moving the car unassisted (Wikipedia, 2006).

It is therefore imperative for automobile roadside mechanics to undergo retraining to acquire the relevant modern skills and impact same on the apprentices to ensure their better performance and satisfaction on jobs and consequently keeping customers coming.

tend to enjoy their job security.

**Concept of Job Performance**

Job performance is a commonly used, yet poorly defined concept in industrial and organizational psychology, the branch of psychology that deals with the workplace. It's also part of Human Resources Management. It most commonly refers to whether a person performs their job well. Despite the confusion over how it should be exactly defined, performance is an extremely important criterion that relates to organizational outcomes and success. Among the most commonly accepted theories of job performance comes from the work of John P. Campbell and colleagues McCoy, R. A., Oppler, S. H., and Sager, C. E. (1993) asserted that coming from a psychological perspective, they described job performance as an individual level variable. That is, performance is something a single person does. This differentiates it from more encompassing constructs such as organizational performance or national performance which are higher level variables.

**Features of job performance**

There are several key features to his conceptualization of job performance which help clarify what job performance means.

First, he defines performance as behavior. It is something done by the employee. This concept differentiates performance from outcomes. Outcomes are the result of an individual's performance, but they are also the result of other influences. In other words, there are more factors that determine outcomes than just an employee's behaviors and actions. He also allows for exceptions when defining performance as behavior. For instance, he clarifies that performance does not have to be directly observable actions of an individual. It can consist of mental productions such as answers or decisions. However, performance needs to be under the individual's control, regardless of whether the performance of interest is mental or behavioral. The difference between individual controlled action and outcomes is best conveyed through an example. On a sales job, a favorable outcome is a certain level of

revenue generated through the sale of something (merchandise, some service, insurance). Revenue can be generated or not, depending on the behavior of employees. When the employee performs this sales job well, he is able to move more merchandise. However, certain factors other than employees' behavior influence revenue generated. For example, sales might slump due to economic conditions, changes in customer preferences, production bottlenecks, etc. In these conditions, employee performance can be adequate, yet sales can still be low. The first is performance and the second is the effectiveness of that performance. These two can be decoupled because performance is not the same as effectiveness Campbell and Weick (1970).

He further stated in 1988 that another closely related construct is productivity. This can be thought of as a comparison of the amount of effectiveness that results from a certain level of cost associated with that effectiveness. In other words, effectiveness is the ratio of outputs to inputs—those inputs being effort, monetary costs, resources, etc.

Utility is another related construct which is defined as the value of a particular level of performance, effectiveness, or productivity. Utilities of performance, effectiveness, and productivity are value judgments.

Another key feature of job performance is that it has to be goal relevant. Performance must be directed toward organizational goals that are relevant to the job or role. Therefore, performance does not include activities where effort is expended toward achieving peripheral goals. For example, the effort put toward the goal of getting to work in the shortest amount of time is not performance (except where it is concerned with avoiding lateness).

**Multidimensionality**

Despite the emphasis on defining and predicting job performance, it is not a single unified construct. There are vastly many jobs each with different performance standards. Therefore, job performance is conceptualized as a multidimensional construct consisting of more than one kind of behavior. Campbell (1990) proposed an eight factor model of

performance based on factor analytic research that attempts to capture dimensions of job performance existent (to a greater or lesser extent) across all jobs.

- The first factor is task specific behaviors which include those behaviors that an individual undertakes as part of a job. They are the core substantive tasks that delineate one job from another.
- On the other hand, non-task specific behaviors, the second factor, are those behaviors which an individual is required to undertake which do not pertain only to a particular job. Returning to the sales person, an example of a task specific behavior would be showing a product to a potential customer. A non-task specific behavior of a sales person might be training new staff members.
- Written and oral communication tasks refer to activities where the incumbent is evaluated, not on the content of a message necessarily, but on the adeptness with which they deliver the communication. Employees need to make formal and informal oral and written presentations to various audiences in many different jobs in the work force.
- An individual's performance can also be assessed in terms of effort, either day to day, or when there are extraordinary circumstances. This factor reflects the degree to which people commit themselves to job tasks.
- The performance domain might also include an aspect of personal discipline. Individuals would be expected to be in good standing with the law, not abuse alcohol, etc.
- In jobs where people work closely or are highly interdependent, performance may include the degree to which a person helps out the groups and his or her colleagues. This might include acting as a good role model, coaching, giving advice or helping maintain group goals.

- Many jobs also have a supervisory or leadership component. The individual will be relied upon to undertake many of the things delineated under the previous factor and in addition will be responsible for meting out rewards and punishments. These aspects of performance happen in a face to face manner.
- Managerial and administrative performance entails those aspects of a job which serve the group or organization but do not involve direct supervision. A managerial task would be setting an organizational goal or responding to external stimuli to assist a group in achieving its goals. In addition a manager might be responsible for monitoring group and individual progress towards goals and monitoring organizational resources.

A different taxonomy of job performance was proposed and developed for the US Navy by Murphy (1994). This model is significantly broader and breaks performance into only four dimensions.

- Task-oriented behaviors are similar to task-specific behaviors in Campbell's model. This dimension includes any major tasks relevant to someone's job.
- Interpersonally oriented behaviors are represented by any interaction the focal employee has with other employees. These can be task related or non-task related. This dimension diverges from “Campbell's taxonomy” because it included behaviors (small talk, socializing, etc.) that are not targeting an organization's goal.
- Down-time behaviors are behaviors that employees engage in during their free time either at work or off-site. Down-time behaviors that occur off-site are only considered job performance when they subsequently affect job performance (for example, outside behaviors that cause absenteeism).
- Destructive/hazardous behaviors

In addition to these models dividing performance into dimensions, others have identified different types of behaviors making up performance.

**Different types of performance**

Another way to divide up performance is in terms of task and contextual (citizenship and counterproductive) behaviors Borman and Motowidlo (1993). Whereas task performance describes obligatory behaviors, contextual behaviors are behaviors that do not fulfill specific aspects of the job's required role. Citizenship behaviors are defined as behaviors which contribute to the goals of the organization through their effect on the social and psychological conditions Rotundo and Sackett (2002). Counterproductive behaviors, on the other hand, are intentional actions by employees which circumvent the aims of the organization Sackett and DeVore (2001).

**Determinants of performance**

A meta-analysis of selection methods in personnel psychology found that general mental ability was the best overall predictor of job performance and training performance Schmidt and Frank (1998). Campbell (1990) also suggested determinants of performance components. Individual differences on performance are a function of three main determinants: declarative knowledge, procedural knowledge and skill, and motivation. He also asserted that declarative knowledge refers to knowledge about facts, principles, objects, etc. It represents the knowledge of a given task's requirements. For instance, declarative knowledge includes knowledge of principles, facts, ideas, etc. He also said if declarative knowledge is the knowing of what to do, procedural knowledge and skill is the knowing of how to do it. For example, procedural knowledge and skill includes cognitive skill, perceptual skill, interpersonal skill, etc.

The third predictor of performance is motivation, which refers to "a combined effect from three choice behaviors—choice to expend effort, choice of level of effort to expend, and choice to persist in the expenditure of that level of effort" (Campbell, 1990). It reflects the

direction, intensity, and persistence of volitional behaviors Dalal and Hulin (2008). He went further to emphasized that the only way to discuss motivation as a direct determinant of behavior is as one or more of these choices. More so, in his statement, he mentioned several performance parameters that may have important implications for the job performance setting and should be investigated by industrial and organizational psychologists.

The first one is the distinction between speed and accuracy. This distinction is similar to the one between quantity and quality Dalal and Hulin (2008). Important questions that should be considered include: which is most valued by the organization, maximized speed, maximized accuracy, or some balance between the two? What kind of tradeoffs should an employee makes? The latter question is important because speed and accuracy for the same task may be independent of one another.

The second distinction is between typical and maximum performance. Zedeck, and Sackett, Zedeck and Fogli (1988), did a study on supermarket cashiers and found that there was a substantial difference between scores reflecting their typical performance and scores reflecting their maximum performance. This study suggested the distinction between typical and maximum performance. Regular work situations reflect varying levels of motivation which result in typical performance. Special circumstances generate maximum employee motivation which results in maximum performance.

Additionally, the impact of organizational justice perceptions on performance is believed to stem from Equity Theory. This would suggest that when people perceive injustice they seek to restore justice. One way that employees restore justice is by altering their level of performance. Procedural justice affects performance as a result of its impact on employee attitudes. Distributive justice affects performance when efficiency and productivity are involved Cohen and Spector (2001). Improving justice perceptions improves productivity and performance.

**Core self-evaluations**

Job performance is a consistent and important outcome of core self-evaluations Collins and Judge (2009). The concept of core self-evaluations was first examined by Locke and Durham (1997) as a dispositional predictor of job satisfaction, and involves four personality dimensions; locus of control, neuroticism, self-efficacy, and self-esteem. He also stated that the way in which people appraise themselves using core self-evaluations has the ability to predict positive work outcomes, specifically, job satisfaction and job performance. The most popular theory relating the core self- evaluation (CSE) trait to job performance argues that people with high CSE will be more motivated to perform well because they are confident they have the ability to do so. He further stated that motivation is generally the most accepted mediator of the core self-evaluations and job performance relationship. More so, he added that these relationships have inspired increasing amounts of research on core self-evaluations and suggest valuable implications about the importance this trait may have for organizations.

**Maintenance in Automobile Technology**

The term maintenance has no universal definition. It means different things to different people, depending on the way it is perceived (Ogbuanya 1999; Fajimi, 2004; Narayan, 2004). However, some definitions are worth considering.

Maintenance Olaitan (1999) means taking specific approved steps and precautions to care for a piece of equipment, machinery or facility and ensure that it attains its specific maximum functional self-life. Cole (1990) cited in Chidindu (2001) defined maintenance as the keeping of equipment or a system in working order or in the alternative, in returning equipment or a system to working order. Orikpe (1994) cited in Ogbuanya (1999), stated that maintenance is a deliberately planned action aimed at ensuring that a given piece of equipment functions as specified by the manufacturers. It is a combination of actions carried out to retain an item in or restore it to an acceptable condition Makun (1988). As defined by Allian (1991), maintenance is the combination of all technical and associated administrative actions intended to retain an.item in or restore it to, a state in which it can

perform its required function. As if looking at it cumbersome, Uchebo (1988) viewed it as a complex and many-faceted activity which until recently has attracted little serious study and implementation. Fajimi (2004) defined maintenance as a combination of any action carried out to retain an item in or restore it to normal operation standard.

Maintenance involves the continued sustenance of equipment operation. It activities always involve decision-making and planning by the personnel involved Ogbuanya (1999). Maintenance helps maximize the profitability of a business over its life Narayan (2004). Maintenance has been classified differently by different authors Ogbuany (1999). Norman (1972) and Fajimi (2004) classified maintenance into two groups, namely, planned maintenance and unplanned maintenance. Olaitan (1989), Orikpe (1994), and Storm (1976) cited in Ogbuanya (1999) classified maintenance into three groups which can be summarized as predictive, preventive and corrective maintenance. Narayan (2004) expanded his classification as follows:

- Breakdown maintenance: Repair is done after functional failure of equipment, so it is not possible to schedule the repair work.
- Corrective maintenance: Repair is done after initiation of failure, leading to degraded performance. The key difference from breakdown maintenance is this - we were aware of the functional failure before it occurred, so we had an opportunity to schedule the repair.
- Scheduled overhand or replacement or hard-time maintenance: Repair is done based on age (calendar time, number of cycles, number of starts or similar measures of age as appropriate).
- On-condition maintenance: Repair is based on the result of inspections or condition-monitoring activities, which they scheduled on calendar time to discover if failure has already commenced. Note that, all on-condition maintenance is corrective

maintenance.

- Testing or failure-finding: Is aimed at finding out whether an item is able to work if required to do so on demand.
- Predictive maintenance: Repair is based on predicted time of functional failure, generally by extrapolating from the results of on-condition activities or continuously monitored condition readings. It is synonymous with on-condition maintenance.
- Preventive maintenance: Repair or inspection task is carried before functional failure. It may be done even when the equipment is in perfect operating conditions.

Ogbuanya (1999) however, opined that, maintenance can be broadly classified into two, preventive and corrective maintenance. Her reason, as stated, is because other classes of maintenance can either be for prevention or correction as the case may be. Considering the sophistication, complexity and technological advancements made on the modern automobile as well as future trends in automobile industry, I hold to the opinion of classification of maintenance in three categories: predictive, preventive and corrective maintenance, respectively. According to Olaitan et al (1999), predictive maintenance is concerned with the' application of useful strategies to forestall a breakdown when danger signals are observed.

This type of maintenance is vital to the modern automobile considering the incorporation of on-board-diagnostic system or electronic control unit in today's automobile. Similarly, Orikpe (1994) cited in Ogbuanya (1999) posited predictive maintenance implies watching out for danger signals such as unusual noise, danger light indicators, inefficiency of performance and arresting the situation promptly before there is any major breakdown. This is necessary in today's automobile if they are to maintain peak performance and attain their specific maximum functional self-lives. Preventive maintenance (Olaitan et ai, 1999) is a type of practice that involves inspection lubrication, cleaning and testing of an equipment or facility used in the factory or laboratory. Bernard and Leonard (1973) perceived preventive maintenance as 'that type of maintenance which inspects, adjusts, repairs and replaces

equipment on an economic basis at calculated intervals before failure could force an emergence shutdown. This is required for the routine maintenance of automobiles.

As earlier stated, Narayan (2004) defined corrective maintenance as repair that is done after initiation of failure, leading to degraded performance. Olaitan (1999) puts it more comprehensive and elaborate as maintenance involving approaches for rectifying an already damaged or broken-down equipment or machinery. Steps to be taken, according to them, may be replacement of already damaged parts or repair and servicing. Corrective maintenance is the maintenance necessary for the return of broken down automobiles to working order (Cole 1990 cited in Chidindu, 2001). Without the right maintenance skill and knowledge, it is almost impossible for personnel involved in maintenance to do the right thing as far as maintenance is concerned (Ogbuanya, 1999). For the technician to be involved in automobile maintenance, Oni and Igwe (1988) cited in Ogbuanya stated that he should be equipped with the knowledge and expertise to properly diagnose maintenance problems, prescribe workable solutions and where necessary, design improved alternative parts and system. This poses a big challenge to the automobile technician.

**Review of Related Empirical Studies**

The objective of this section is to review the available studies conduction by other researchers that are related to the present studies. These include the ones of Zirkie (1998), Dare and Leach (1999), Onyeachigbulam (2004), Anthony (2004), Muftan (2004), Madu (2004), and Zaiyadi (2005). Zirkle (1998) studied the perceptions of vocational educators and human resource/training and development professionals regarding skill dimensions of school-to- work transition programme in Indiana. The study was survey design, a descriptive research. A total population of 921 was used. The American Society for Training and Development (ASTD) list contained 467 active members, while the list for vocational educators contained 454 names. From the two populations, a simple random sample of 64 participants was chosen from each group, for a total of 128. Four research questions posed by

the questionnaire were analyzed via a t-test for two independent samples at 0.05 level of significance. Data were input into the statistical analysis programme (SPSS) for windows.

Findings of the study revealed that, both groups perceived academic skills as a school domain and recommended the school for its delivery. Each group perceived itself having a greater than equal responsibility on school-to-work transition programme than the other, and therefore no consensus was reached on which group should be responsible for it. Similarly, both groups perceived a somewhat greater role for their group on evaluation of achievement and mastery of occupation/technical skills than did the other therefore, no consensus reached on it also. Each group also perceived the development of employability skills as its role and was therefore undecided. In a related study, Dare and Leach (1999) studied preparing tomorrow's human resource development (HRD) professionals: perceived relevance of the 1989 competency model in Illinois. Participants selected for the study were faculty who teach in programmes in institutions that are members of the University Council for Vocational Education (UCVE). A three-column questionnaire was developed for the study. Of the 430 surveys mailed to respondents, 164 were returned of which 137 were usable. A four point rating scale was used at 0.05 level of significance. Two-tailed t-test was used to determine significant difference between pairs of responses. Findings disclosed that, competencies for training that were defined in 1989 were still considered important in the study. Three competencies were perceived as significantly more important by participants in the study than participants in the 1989 study. The competencies were technical competency of vision skill. They recommended that, the 1989 competencies were still important and therefore appropriate for use at least for training trainers. The study also recommended the competencies included in the preparation of human resource development personnel be aligned with traditional and emerging roles of human resource development professionals, including training. Anthony (2004) studied safety practice skills needed by woodwork students of technical colleges in Kaduna State. The study was survey design. It was carried

out in Kaduna State within the 3 educational zones namely: Zaria, Kaduna, Kafanchan, Zonkwa, Anchau, Lere, Kachia and Sabon Tasha. The entire population of 108 was used for study. Questionnaire which was face-validated was used as instrument for data collection. Product moment correlation coefficient was needed to establish the reliability of the instrument. Questionnaires were administered and retrieved personally by the researcher with the help of assistants. Mean, standard deviation and t-test was used for analysis of data at 0.05 level of significance.

Findings of the study revealed that, students agreed on the need of all the 16 safety skills in using woodwork hand tools, the need of all the 10 safety observance items identified in use of instructional operating guide in the woodwork laboratories. Recommendations made were: safety practice skills identified should be integrated into woodwork curriculum in technical colleges for teachers to use during training of woodwork students. Also, teacher should emphasize the integrated safety practice skills identified by the study during laboratory work with students.

Muflau (2004) carried out his study on skill improvement needs of nomadic teachers in animal production in Niger State. It was also survey design. The study was carried out in Minna, Kontagora and Bida Emirate Councils respectively. 100 nomadic teachers and 18 nomadic extension agents constituted the population. The questionnaire was his instrument for data collection. It was face validated and Chronbach Alpha used to establish its reliability. The questionnaires were administered and retrieved personally by the researcher with the help of two assistants. The statistical tool for analysis used was frequency table mean and t-test at 0.05 level of significance.

**Summary of Reviewed Literature**

The assessment of job satisfaction and performance of road side automobile mechanics was discussed. The automobile technology and innovation was also discussed. Innovations in automobile are so obvious in modern vehicles to the extent that, diagnosis, maintenance and

repairs are becoming difficult for the road side auto mechanics in Minna. Most of the literature reviewed agreed that apprenticeship system of training roadside auto mechanics has numerous lapses because it is not based on modern pedagogy of training and is therefore gradually losing significance. More so, lapses in the competencies of automobile roadside mechanics in handling modern automobiles appear to pose challenges to their job performance and job satisfaction.

Consequently, the literature review also revealed the extent of job satisfaction and performance of the road-side auto mechanics in maintaining today's automobile as well as lackadaisical attitude of the government in assisting of road-side auto mechanics in Niger State by organizing training programme that will help in updating their performance. There was then the need to carry out empirical studies on assessment of job satisfaction and performance by road-side auto mechanics in meeting challenges of maintaining modem automobile in Minna metropolis.

# CHAPTER THREE

# METHODOLOGY

This chapter deals with the description of the procedures used in carrying out this study. It includes the research design, area of the study, population of the study, instrument for data collection, validation of the instrument, administration of the instrument, method of data analysis, and decision rule.

## Research Design

The study adopted the survey research design. Olaitan and Nwoke (1999) defined a survey method of research as a descriptive study in which the entire population or respective sample of the entire population is studied by collecting and analyzing data from the group through the use of questionnaires. The survey research method would be used because the study shall employ the use of questionnaire as instrument to seek the opinions, responses and perception on job performance of road-side mechanics in maintaining modern automobile in Minna Metropolis.

## Area of Study

The study covered road-side mechanics in major locations minna metropolis.

## Population

The targeted population for this study consisted of 145 automobile Automobile road-side mechanic and vehicle owners. 95 automobile road-side mechanics and 50 vehicle owners in Minna metropolis.

**Sample**

Convenient sampling was used in this study as a result of the scattered settlement or locations of automobile roadside mechanic workshops in Minna metropolis. A total of 145 automobile road-side mechanics and vehicle owners were selected from 5 major locations in Minna.

Table 1 shows the sample distribution based on location within Minna Metropolis.

**Table I**

**Distribution of the Sample of the respondent**

| Location | Automobile Road-side mechanics | Vehicle owner |
|---|---|---|
| Chanchaga | 20 | 10 |
| Tunga | 20 | 10 |
| Kpakungu | 20 | 10 |
| Bosso | 20 | 10 |
| Maikunkele | 15 | 10 |
| **Total** | **95** | **50** |

**Instrument for Data Collection**

In this study, a structured questionnaire was the instrument used for data collected for the study. The questionnaire items were arranged based on the research questions and hypothesis and were aimed at eliciting information from the respondents. The questionnaire was developed by the researcher and divided into 4 sections A, B, C and D as shown below:

SECTION A: Deals with the respondent personal data

SECTION B: Deals with the skills performance required in diagnosing fault in modern automobile.

SECTION C: Identified the modern equipment needed to achieve job satisfaction for auto users.

SECTION D: Determined the strategies that will be adopted to meet the need for job performance for auto practitioners.

**Validation of the Instrument**

To ensure the validity of the instrument used for the study, three (3) automobile lecturers in Industrial and Technology Education Department, Federal University of Technology, Minna validated it. Suggestions made by these lecturers were reflected in the instrument before the final copy of the instrument before administering for reliability test.

**Administration of the Instrument**

The instrument was administered by the researcher. The questionnaires enabled the researcher to obtain data on the feelings and perception of the job performance of automobile roadside mechanics in Minna Metropolis. Most of the respondents have low education attainment. Some of them are secondary school drop-outs while some are primary school leaving certificate holders. Where a respondent could not read or write, the research interpreted the questions and helped to fill in their responses on the questionnaires.

**Method of Data Analysis**

Mean ($\bar{X}$) and, Standard Deviation (SD) were used to answer the research questions. While t-test was used to test the hypotheses at 0.05 level of significant.

A four point rating scale was used to determine the level of acceptance of the respondents in the following order:

Strongly Agreed (SA) = 4 points

Agreed (A) = 3 points

Disagreed (D) = 2 points $\frac{4+3+2+1}{4} = 2.50$

Strongly Disagreed (SD) = 1 point

**Decision Rule**

To determine the acceptance or rejection level of each item in each research question, a mean score of 2.50 was used as cut-off point. Therefore any item that attracts up to 2.50 and above was considered Agreed. While, those items with mean of 2.49 below was considered Disagreed.

# CHAPTER IV

# PRESENTATION AND ANALYSIS OF DATA

This chapter presents the analysis of data collected for the study. The data presentation and analysis were organized according to the research questions and the hypotheses tested for the study.

## RESEARCH QUESTION 1

What are the skill performances required by road-side mechanics in the diagnosing faults in modern automobile?

**TABLE II:**

**Mean Responses of Automobile road-side mechanics and vehicle owners on the skill Performances required by Road-Side Mechanics in the Diagnosing Faults in Automobiles.**

$N_1$= 95 $N_2$=50

| S/N | Items | $\bar{X}_1$ | $\bar{X}_2$ | $\bar{X}_t$ | Remark |
|---|---|---|---|---|---|
| **1** | Conduct engine performance test and determine needed repairs. | 3.58 | 3.40 | 3.48 | Agreed |
| **2** | Perform an on- board computer diagnosis on Electronic Control Unit. | 3.21 | 3.50 | 3.36 | Agreed |
| **3** | Diagnose and carry out needed repairs on multiplex electrics and wiring: signals and current flow controls. | 3.11 | 3.30 | 3.21 | Agreed |
| **4** | Perform oil and lubrication service on normally aspirated and turbocharged engines. | 3.03 | 3.20 | 3.12 | Agreed |
| **5** | Checking mixture regulation function via Electronic Control Unit. | 3.05 | 3.00 | 3.03 | Agreed |
| **6** | Inspect, repair or replace electronic injection components when needed. | 3.09 | 3.10 | 3.10 | Agreed |
| **7** | Diagnose Electronic injection system faults and determine needed repairs. | 3.02 | 3.16 | 3.09 | Agreed |
| **8** | Checking engine speed sensor function via Electronic Control Unit. | 3.00 | 3.24 | 3.12 | Agreed |
| **9** | Checking diagnostic warning light control function via Electronic Control Unit. | 3.04 | 3.64 | 3.34 | Agreed |
| **10** | Checking coolant temperature warning lamp function via Electronic Control Unit. | 3.08 | 3.16 | 3.12 | Agreed |
| **11** | Use of diagnostic equipment to diagnose a faulty carburetor for adjustment and repair. | 3.05 | 3.10 | 3.08 | Agreed |
| **12** | Use ignition timing light to check the spark advance for the ignition timing setting. | 3.03 | 3.06 | 3.05 | Agreed |

**Key**

$N_1$ = Numbers of automobile road-side mechanics

$X_1$ = mean of automobile road-side mechanics

$N_2$ = numbers vehicle owners

$X_2$ = average mean of vehicle owners

Table II: Revealed that the two categories of respondents agreed with items 1-12 at a cut-off point of 2.50 with average mean ranging from (3.03 - 3.43).

**RESEARCH QUESTION 2**

What are the modern equipments needed by auto mechanics to achieve job satisfaction for vehicle users?

**TABLE III:**

**Mean responses of the modern equipment needed by auto mechanics to achieve job satisfaction for vehicle users**

$N_1 = 95$ $N_2 = 50$

| S/N | Items | $\bar{X}_1$ | $\bar{X}_2$ | $\bar{X}_t$ | Remarks |
|---|---|---|---|---|---|
| **13** | Tachometer | 3.16 | 3.28 | 3.22 | Agreed |
| **14** | Cylinder compression tester | 3.21 | 3.04 | 3.13 | Agreed |
| **15** | Cylinder leakage tester | 3.05 | 3.20 | 3'13 | Agreed |
| **16** | Engine vacuum gauge | 3.11 | 3.08 | 3.10 | Agreed |
| **17** | Exhaust gas analyzer | 3.07 | 3.04 | 3.06 | Agreed |
| **18** | Ignition timing light | 3.01 | 3.12 | 3.07 | Agreed |
| **19** | Dwell meter | 3.00 | 3.10 | 3.05 | Agreed |
| **20** | Chassis dynamometer | 3.09 | 3.08 | 2.96 | Agreed |
| **21** | Oscilloscope | 3.05 | 3.22 | 3.14 | Agreed |
| **22** | Engine analyzer | 3.03 | 3.06 | 3.05 | Agreed |
| **23** | Filler Gauge | 3.01 | 3.02 | 3.02 | Agreed |

Table III: Revealed that the two categories of respondents agreed with items 13-23 at a cut-off point of 2.50 with average mean ranging from (2.96 - 3.22).

**RESEARCH QUESTION 3**

What are the strategies that will be adopted to meet the need for job performance of auto practitioners?

**TABLE IV: Mean Responses of the strategies that will be adopted to meet the need for job performance of auto practitioners.**

$N_1$= 95 $N_2$= 50

| S/N | Items | $\bar{X}_1$ | $\bar{X}_2$ | $\bar{X}_t$ | Remarks |
|---|---|---|---|---|---|
| **24** | Organizing general automobile workshop training center by Automobile Technician Association. | 3.58 | 3.30 | 3.44 | Agreed |
| **25** | Support from state government in organizing training programme to update road-side auto mechanics performance. | 3.84 | 3.20 | 3.52 | Agreed |
| **26** | Encouraging Vocational and Technical Institutions in the state by government to take maximum use of their available equipment and facilities for training programmes for road-side auto mechanics. | 3.32 | 3.18 | 3.25 | Agreed |
| **27** | Provision of automobile equipment and facilities for road-side auto mechanics by the state government. | 3.79 | 3.10 | 3.45 | Agreed |
| **28** | Employment of an expert that is updated in electronic and computer cars for the training programme of road side mechanics. | 3.26 | 3.16 | 3.21 | Agreed |
| **29** | Accreditation modalities for road-side auto mechanics after completing training programmes through non-formal education by National Board for Technical Education. | 3.11 | 3.12 | 3.12 | Agreed |
| **30** | Road-side auto mechanics should equip their workshop with modern equipment. | 3.91 | 3.70 | 3.81 | Agreed |
| **31** | Encouragement from car owners in respect to workmanship charges. | 3.53 | 3.08 | 3.31 | Agreed |
| **32** | Automobile manufacturers should organize seminars and workshop training with road-side auto mechanics. | 3.68 | 3.16 | 3.42 | Agreed |
| **33** | Road-side auto mechanics should stay current with changes in automobiles production. | 3.17 | 3.10 | 3.14 | Agreed |

Table IV: Revealed that the two categories of respondents agreed with items 35-43 at a cut-off point of 2.50 with average mean ranging from (3.12 - 3.81).

**$H0_1$:**

There was no significant difference between the mean responses of Automobile road-side mechanics and vehicle users on the skill performance required in diagnosing fault in modern automobile.

**TABLE V:**

| S/N | Items | $\bar{X}_1$ | $SD_1$ | $\bar{X}_2$ | $SD_2$ | t-cal | Remarks |
|---|---|---|---|---|---|---|---|
| **1** | Conduct engine performance test and determine needed repairs. | 3.58 | 0.32 | 3.40 | 0.41 | 2.70 | S |
| **2** | Perform an on- board computer diagnosis on Electronic Control Unit. | 3.21 | 0.27 | 3.50 | 0.43 | 4.34 | S |
| **3** | Diagnose and carry out needed repairs on multiplex electrics and wiring: signals and current flow controls. | 3.11 | 0.26 | 3.30 | 0.39 | -3.10 | NS |
| **4** | Perform oil and lubrication service on normally aspirated and turbocharged engines. | 3.03 | 0.26 | 3.20 | 0.38 | -2.83 | NS |
| **5** | Checking mixture regulation function via Electronic Control Unit. | 3.05 | 0.26 | 3.00 | 0.35 | 0.89 | NS |
| **6** | Inspect, repair or replace electronic injection components when needed. | 3.09 | 0.26 | 3.10 | 0.36 | -0.17 | NS |
| **7** | Diagnose Electronic injection system faults and determine needed repairs. | 3.02 | 0.25 | 3.16 | 0.37 | -2.40 | NS |
| **8** | Checking engine speed sensor function via Electronic Control Unit. | 3.00 | 0.25 | 3.24 | 0.38 | -4.03 | NS |
| **9** | Checking diagnostic warning light control | 3.04 | 0.26 | 3.64 | 0.46 | -8.53 | NS |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | function via Electronic Control Unit. | | | | | | |
| **10** | Checking coolant temperature warning lamp function via Electronic Control Unit. | 3.08 | 0.26 | 3.16 | 0.37 | -1.36 | NS |
| **11** | Use of diagnostic equipment to diagnose a faulty carburetor for adjustment and repair. | 3.05 | 0.26 | 3.10 | 0.36 | -0.87 | NS |
| **12** | Use ignition timing light to check the spark advance for the ignition timing setting. | 3.03 | 0.26 | 3.06 | 0.26 | -0.52 | NS |

**t-test analysis of Automobile road-side mechanics and vehicle users on the skill performance required by road-side mechanics in the diagnosing faults in modern automobiles.**

$N_1 = 95$ $N_2 = 50$

**Key:**

$N_1$ = number of automobile road-side mechanics

$N_2$ = number of vehicle owners

$SD_1$ = standard deviation of automobile road-side mechanics

$SD_2$ = standard deviation of vehicle owners

t-cal = t-calculated. t-critical (t-table value) = ± 1.98

$X_1$ = mean of automobile road-side mechanics

$X_2$ = mean of vehicle owners

S = significant

NS = not significant

df (degree of freedom) $=(N_1 + N_2) - 2 = (95 + 50) - 2 = 143$

The analysis in Table V showed that the t-cal values of 2 items; 1 and 2 were greater than the t-value, while 10 items; 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 were below the t-value (± 1.98) of 143 degree of freedom. Therefore, the null hypothesis was rejected for each of the 2 items, while it was accepted for each of the 10 items. This implies that there is no significant

difference for items accepted but there is significance difference for the items rejected in the mean rating of Automobile road-side mechanics and vehicle users on the skill performance required by road-side mechanics in the diagnosing faults in modern automobile.

**$H0_2$:**

There was no significant difference between the mean responses of Automobile road-side mechanics and vehicle users on the modern equipment needed by auto mechanics to achieve job satisfaction for vehicle users.

**TABLE VI:**

**t-test analysis of Automobile road-side mechanics and vehicle users on the modern equipments needed by auto mechanics to achieve job satisfaction for vehicle users.**

$N_1 = 95$ $N_2 = 50$

| S/N | Items | $\bar{X}_1$ | $SD_1$ | $\bar{X}_2$ | $SD_2$ | t-cal | Remarks |
|---|---|---|---|---|---|---|---|
| **13** | Tachometer | 3.16 | 0.27 | 3.28 | 0.39 | -1.94 | NS |
| **14** | Cylinder compression tester | 3.21 | 0.27 | 3.04 | 0.35 | 2.99 | S |
| **15** | Cylinder leakage tester | 3.05 | 0.26 | 3.20 | 0.38 | -2.50 | NS |
| **16** | Engine vacuum gauge | 3.11 | 0.26 | 3.08 | 0.36 | 0.52 | NS |
| **17** | Exhaust gas analyzer | 3.07 | 0.26 | 3.04 | 0.35 | 0.53 | NS |
| **18** | Ignition timing light | 3.01 | 0.25 | 3.12 | 0.37 | -1.89 | NS |
| **19** | Dwell meter | 3.00 | 0.25 | 3.10 | 0.36 | 1.75 | NS |
| **20** | Chassis dynamometer | 3.09 | 0.26 | 3.08 | 0.36 | 0.17 | NS |
| **21** | Oscilloscope | 3.05 | 0.26 | 3.22 | 0.38 | -2.83 | NS |
| **22** | Engine analyzer | 3.03 | 0.26 | 3.06 | 0.36 | -0.52 | NS |
| **23** | Filler Gauge | 3.01 | 0.25 | 3.02 | 0.35 | -0.18 | NS |

The analysis in table VI showed that the t-cal values of all the items were below the t-table value except for item 14.

Therefore, the null hypothesis was rejected for the item 14, while it was accepted for each of the 10 items. Hence the opinion of the respondents differed in one item but did not differ in

ten items in relation to the modern equipments needed by auto mechanics to achieve job satisfaction for vehicles users.

**Findings of the Study**

Base on the data collected and analyzed, the following findings were made according to the researcher questions raised for study.

Findings related to the skill performances required by road-side mechanics in the diagnosing fault of modern automobile vehicles.

1. Conduct engine performance test and determine needed repairs.
2. Perform an on- board computer diagnosis on Electronic Control Unit.
3. Diagnose and carry out needed repairs on multiplex electrics and wiring: signals and current flow controls.
4. Perform oil and lubrication service on normally aspirated and turbocharged engines.
5. Checking mixture regulation function via Electronic Control Unit.
6. Inspect, repair or replace electronic injection components when needed.
7. Diagnose Electronic injection system faults and determine needed repairs.
8. Checking engine speed sensor function via Electronic Control Unit.
9. Checking diagnostic warning light control function via Electronic Control Unit.
10. Checking coolant temperature warning lamp function via Electronic Control Unit.
11. Use of diagnostic equipment to diagnose a faulty carburetor for adjustment and repair.
12. Use ignition timing light to check the spark advance for the ignition timing setting.

Findings related to the modern equipment needed by auto mechanics to achieve job satisfaction for vehicle users.

1. Tachometer
2. Cylinder compression tester
3. Cylinder leakage tester
4. Engine vacuum gauge
5. Exhaust gas analyzer
6. Ignition timing light
7. Dwell meter
8. Chassis dynamometer
9. Oscilloscope
10. Engine analyzer
11. Filler Guage

Findings related on the strategies that will be suitable to meet the need for job performance of auto practitioners.

1. Organizing general automobile workshop training center by Automobile Technician Association.
2. Support from state government in organizing training programme to update road-side auto mechanics performance.
3. Encouraging Vocational and Technical Institutions in the state by government to take maximum use of their available equipment and facilities for training programmes for road-side auto mechanics.
4. Provision of automobile equipment and facilities for road-side auto mechanics by the state government.
5. Employment of an expert that is updated in electronic and computer cars for the training programme of road side mechanics.

6. Accreditation modalities for road-side auto mechanics after completing training programmes through non-formal education by National Board for Technical Education.
7. Road-side auto mechanics should equip their workshop with modern equipment
8. Encouragement from car owners in respect to workmanship charges.
9. Automobile manufacturers should organize seminars and workshop training with road-side auto mechanics.
10. Road-side auto mechanics should stay current with changes in automobiles production.

**Discussion on the Major Findings**

The data presented in the table II provided answers to research question on which is on the skill performances required by road-side mechanics in the diagnosing faults in modern automobile. The table revealed that all the 12 items have their mean score ranked above 2.50 mark, the table recorded high degree of acceptance with mean scores above (3.03-3.43)

The table revealed that road-side auto mechanics lack the high tech skills needed to repair today's cars. Okorie (2000) observed that, the orthodox skills of auto mechanics have been rendered valueless by the emergence of computer technology in modern automobiles. This is in line with Bailey and Merritt (1995), who disclosed that, technology and market changes have caused significant modifications in the types of skills and behaviours needed by workers on the job.

Findings also revealed low level skill development among auto technicians. Okorie (2000) noted as well that, there is high rate of low skill development in Nigeria's Technical colleges who produce these technicians. International Labour Organisation ILO (1999) report stated that up skilling of auto technicians is a paramount objective in a changing market place.

It means acquiring skills that take the existing work to higher levels. The result also shows that training and retraining of today's Auto mechanics is imperative for them to remain relevant in the automobile industry. Gross (2004) supported this assertion when he stated that the high tech nature of today's car mandates the need for regular road side mechanics training.

Findings also revealed that auto mechanics repair shop lack the basic diagnostic (on-board and off-board) equipment needed for diagnosis, service and repair of modern automobiles. Adeshina (1984) stated that the quality of education the people receive is directly related to the availability or the lack of facilities.

The findings from the table revealed that auto mechanics lack the knowledge of the performance required to maintain modern cars as revealed by high degree of acceptance in all the 12 items listed. NYSADA (2006) revealed that, the service technician job in today's market is more skilled and challenging than ever before. New cars and trucks are more complex than they used to be and a modern service bay is beginning to look like a science lab with lots of expensive sophisticated diagnostic and repair equipments, including computers, NYSADA further shows that because cars have progresses so rapidly in recent years, one cannot longer rely on amateur knowledge of trial and error to repair the cars of today.

Modern vehicles use sophisticated computer technology, advanced wiring, intricate circuit, and complex engineering (Marone, 2006). NYSADA (2006) stated that, auto Technicians must have an extensive knowledge of mechanical, electronic and computer technology, and this knowledge, NYSADA added, must be updated constantly to keep pace with rapid change. Auto Technicians lacks the knowledge and the skills needed for electronic injection system.

The data presented in table III, provided answers to research question two, which is on the equipments needed by Road-side auto mechanics to achieve job satisfaction for vehicle user. The table revealed that all the 11 items have their mean score ranked above 2.50 mark, the table recorded high degree of acceptance with mean scores above (2.96-3.22). This

revealed that road-side auto mechanics need training and retraining in the use of diagnostic equipment to diagnose all automobile basic system. The use of diagnostic equipment to diagnose automobile basic systems has direct linkage with electronic injection system diagnosis.

The findings from the table revealed auto mechanics lack of knowledge and skill to use diagnostic equipment to diagnose faulty automobile basic system. Schwallez (1993) observed that, the development of on-board computers in automobiles to monitor control performance and the other mechanical systems pose greater challenges to the Auto technicians in the knowledge and skills needed for effective maintenance of the modern automobiles. Malone (2006) stated that, since 1996, cars have been equipped with second generation OBD-2 systems. Today's mechanics according to him must be specifically trained and equipped for OBD-2 system technology to avoid potential costly errors in diagnosing cars trouble codes and making appropriate repairs. Results of findings revealed that road-side auto mechanics don't have this knowledge and training.

Osinem and Nwoji (2005) noted that, a framing need may be said to be existing anytime an "actual condition" differs from a "desired condition" which in the human or people or aspect of organization performance. More specifically, with a change in present human knowledge, skills or attitudes can bring about the desired performance. Relating it to occupation, Osinem and Nwoji stated that, an occupation training need exists when:

- Those in particular jobs or occupations lack the necessary skills, knowledge or attitudes required for effective carrying out of duties involved.
- Deficiency in particular skills, knowledge and attitudes are identified in specific individuals.

This is the case as revealed by the result in Table III. Road-side auto mechanics therefore need retraining in the use of diagnostic equipment to diagnose faulty automobile basic systems.

The data presented in Table IV provided answers to research question three which is on the strategies that will be suitable to meet the need for job performance for auto practitioners. The result from this table shows that all the 10 items have their mean score ranked above 2.50. This is an indication that road side auto mechanics need retraining in areas of electronic and electrical principles, electronic sensor, use of equipment to diagnose and determine needed fault repair etc.

The finding from the table revealed that many road-side auto mechanics lacks the knowledge and skills in auto-electricity. Many of them, the result shows, concentrate on repair work. This is in line with NYSADA (2006), which stated that because it is more difficult today for the service technicians to make all necessary repairs on cars and trucks, many dealership employ service specialist who concentrate their skills in a single area such as: Tune-up and diagnosis, electrical systems, front end and steering, automotive transmission, air conditioning, brakes, radiators, diesel engines or light and heavy truck repairs.

Finding also revealed that, the introduction of electronic sensors, circuits and computers in Auto-electricity makes it difficult, complex and more sophisticated for diagnosis, service repairs. Schwallez (1993) stated also that, the automobile today is controlled by various electronic sensors, circuits and computers. The automotive service technician, he added, must have a sound knowledge of electrical principles and troubleshooting procedures to diagnose and service many of the electrical problems found in the automobile.

# CHAPTER V

# SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter deals with the re-statement of the problems, summary of the procedures used, principal findings, implication of the study, conclusion, recommendation and suggestion for further study.

## Re-statement of the problem

Modern cars use sophisticated computer technology, advanced wiring, intricate circuitry and complex engineering (Malone, 2006). He stated that, since 1996, cars have been equipped with second- generation on-board- diagnostic (OBD)-2 systems. Schwallez (1993) disclosed that, the automobile today is controlled by various electronic sensors, circuits and computers. NYSADA (2006) noted that, the services technician job in today's market is more skilled and challenging than ever before.

Schwallez (1993) stated that, the automotive service technician must have sound knowledge of electrical principles and troubleshooting procedures to diagnose and service many of the problems found in the automobile. NYSADA (2006) also disclosed that Auto Technicians must have an extensive Knowledge of mechanical, electronic and computer technology and this knowledge must be updated constantly to keep pace with rapid change. Malone (2006) further stressed that today's Auto Technician must be specifically trained and equipped for OBD-2 technology to avoid potential costly errors in diagnosing cars trouble codes and making appropriate repairs.

To effectively service and repair today's high-tech Malone reiterated the professional automobile technician must have training and experience in a diverse range of subjects including mechanical engineering, electrical engineering, electronics, chemistry, physics, metallurgy, plumbing, safety engineering, welding and metal fabricating, lubricating and hazardous waste handling.

Okerie (2000) disclosed that the orthodox skills of Auto Technician have been rendered valueless by the emergence of computer technology in modern automobiles. Bailey and Merriff (1995) also stated that, technology and market charges have caused significant modifications in the types of skills and behaviors needed by workers on the Job. Okorie (2000) observed that, there is high rate of low-level skill development in technical colleges who produce these technicians. It became effective to carry out this study of human resource development needs of Auto Technician for effective maintenance of automobiles in Minna metropolis.

**Summary of Procedures Used**

The study was a survey design; the instrument used for data collection was a questionnaire. A 33- item questionnaire was constructed by the researcher for the study and

was face-validated by three experts, lecturers in the Department of Industrial and Technology Education, Federal University Of Technology, Minna. The validated questionnaire draft was then administered to 95 Automobile road-side mechanics and 50 vehicle users within Minna metropolis. The result of the study was then tested using t-test of reliability.

The sample size of the study was 145 which consisted of both Automobile road-side mechanics and vehicle users selected from five locations in Minna metropolis: Chanchaga, Bosso, Maikunkele, Tunga and Kpakungu.

The instrument was administered and collected by the researcher. The entire administered questionnaire were duly completed and returned. The data collected from the instrument were by arranging them according to research questions.

A 4- point rating scale ranging from Strongly Agreed, Agreed, Disagreed, Strongly Disagreed with assigned numbers 4, 3, 2, and 1 respectively was adopted. The cut- off point of 2.50 was used for the study. The mean statistics was employed in answering all the three research questions. Any item with a mean score less than 2.50 were rejected.

**Principal Findings**

Based on the data collected and analyzed, the following principal findings were made:

1. Today's cars factories are equipped with computer systems that have more intelligence than the spacecraft NASA sent to the moon.
2. The introduction of electronic sensors, circuits and computers in automobiles makes it difficult, complex and more sophisticated for diagnosis, service and repair.
3. The orthodox skills of road-side auto mechanics have been rendered valueless by the advancement of computer technology in modern automobiles.

4. One can no longer rely on amateur knowledge or trial and error to repair the cars of today.
5. Road-side auto mechanics lack the high-tech skills needed to repair today's cars.
6. Road-side auto mechanics lack the knowledge and skills of injection system diagnosis.
7. Road-side auto mechanics lack the competence and skill to use diagnostic (on-board and off-board) equipment for diagnosis, service and repair of modern automobiles.
8. There is low level skill development among road-side auto mechanics.
9. Road-side auto mechanics lack the basic diagnosis equipments needed to diagnose service and repair of modern cars.
10. Road-side auto mechanics lacks the skills needed for electronic (computer-related) repairs.
11. To remain relevant in the automobile industry, road-side auto mechanics need to update their skills to enable them diagnose, service and repair today's car.
12. Base on this study, it is found out that there is no support from state government.
13. Road-side auto mechanics need continuous training and retraining in automobile maintenance to keep pace with rapid changes in automobile industry.

**Implications of the Study**

The findings of this study have far- reaching implication on road-side auto-mechanics, automobile industry, educational institute and car owners in the following ways:

1. Since the orthodox skills of road-side auto mechanics have been rendered valueless by the emergence of computer technology in automobile, they (road-side auto mechanics) need to update their knowledge and skills to remain relevant in automobile industry. They also need continuous training and re-training in automobile maintenance (especially on-board and off-board diagnostic equipment) to keep pace with the rapid change in the automobile industry.

2. The automobile industries need to increase the production of modern diagnostic equipment use for automobile maintenance and these equipment should not only be made available to road-side auto mechanics but to also affordable to them. If effective maintenance of today's automobiles need to be met, the automobile industries needs to also be involved in training and re-training of road-side auto mechanics by professional auto technicians on the use of these equipments. The training also needs to be continuous to keep pace with changes in the automobile industries.
3. The present curriculum of technical colleges need to be reviewed to incorporate the innovations in the automobiles industries if technical education is to be relevant in providing school-to-job opportunities to students.
4. Since owners and users of today's automobiles carry them back to the industries for maintenance even when faults are minor due to auto mechanics incompetency to repair them, car owners and users will continue to face a great challenge and problems of effectively maintaining their vehicles if the status quo is maintained, resulting to economic waste.

**Conclusion**

Based on the findings of this study, the following conclusions were made:

1. The introduction of electronic sensor, circuits and computers in automobiles makes it difficult, complex and more sophisticated for diagnosis, service and repair.
2. The orthodox skills of auto mechanics have been rendered valueless by the emergence of computerized technology in modern automobiles.
3. Road-side auto mechanics lacks the high-tech competencies needed to repair today's automobiles.
4. Road-side auto mechanics lack the knowledge and skills to use diagnostic (on-board and off-board) equipment for diagnosis, service and repairs of modern cars.
5. There is low level competency development among road-side auto mechanics.

**Recommendation**

The following recommendations are made based on findings of the study.

1. Auto Technicians should equip their workshop with modern diagnostic equipments in order to meet the challenges of maintaining modern cars.
2. Automobile manufacturers should educate mechanics on effective maintenance of today's automobile. This could be achieved through organizing seminars and workshops with road-side auto mechanics.
3. Co-operative education should be incorporated in the curriculum of technical colleges so that students will not learn theory alone in schools, but also practical with real equipments used in the industries.
4. Technical colleges curriculum should be reviewed to reflect present innovations in the automobile industries.
5. The government in collaboration with educational institutions should organize training programmes for road-side auto mechanics.
6. Road-side auto mechanics should acquire computer education especially in relation to automobile maintenance to keep pace with technological advancement.
7. Road-side auto mechanics should stay current with changes in automobiles as each new model years appears.
8. Road-side auto mechanics should acquire the high-tech skills needed for effective maintenance of today's automobile.
9. The automobile industries should not only make modern diagnostic equipment available to mechanics but also affordable.
10. The automobile industries should regularly organize training programmes for road-side auto mechanics on changes or innovations in automobiles.
11. Government should assist auto mechanics with loans to procure modern diagnostic equipments and other equipments in the workshops.

**Suggestions for further Research**

Based on findings of this study, the following suggestions are made for further research:

1. Modern car maintenance: strategies for human capital development.
2. Ways of establishing a modern automobile workshop.
3. Ways of training auto mechanics to meet the challenges of the automobile industries.
4. Developing a mechanism that will enable Automobile Roadside Mechanics to acquire and develop those performance work skills needed to improve their job performance and satisfaction.

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## APPENDIX B

## FORMULARS

Mean $\overline{X} = \frac{\sum fx}{\sum f}$

$\overline{X}$ = Mean

$\sum$ = The Sum of

X= The Frequency of each point in the scale

Standard deviation

$$SD = \sqrt{\frac{\sum(X - \overline{X})2}{N-1}}$$

X = Mean

$\sum$ = The Sum of

X = The Score

N= Number of

t-test Formula

$$\text{t-test} = \frac{\bar{X}1 - \bar{X}2}{\sqrt{\frac{SD_1^2}{N_1} + \frac{SD_2^2}{N_2}}}$$

$\bar{X}_1$ = Automobile Road-side mechanics

$\bar{X}_2$ = Vehicle owners

$SD_1$ = Standard Deviation of Automobile road-side mechanics

$SD_2$ = Standard Deviation of vehicle owners

$N_1$ = Number of Automobile road-side mechanics

$N_2$ = Number of vehicle owners

Hypotheses 1, item 1, standard deviation for Automobile road-side mechanics responses

| S/N | F | FX | $X - \bar{X}$ | $(X - \bar{X})^2$ | $F(X - \bar{X})^2$ |
|---|---|---|---|---|---|
| 4 | 55 | 220 | 0.42 | 0.18 | 9.70 |
| 3 | 40 | 120 | -0.58 | 0.34 | 13.46 |
| 2 | 0 | 10 | -1.58 | 2.49 | 0.00 |
| 1 | 0 | 0 | -2.58 | 6.66 | 0.00 |
| | $\sum f = 95$ | $\sum fx = 340$ | | $\sum(X - \bar{X})^2 = 9.67$ | $\sum f (X - \bar{X})^2 = 23.16$ |

$$\bar{X}_1 = \frac{\sum FX}{\sum FX} = \frac{340}{95} = 3.58$$

$$SD_1 = \sqrt{\frac{\sum(X - \bar{X})2}{N-1}} = \sqrt{\frac{9.67}{95-1}} = \sqrt{0.10} = 0.32$$

Hypotheses 1, item 1, standard Deviation for Vehicle owners responses

| S/N | F | FX | $X - \bar{X}$ | $(X - \bar{X})^2$ | $F(X - \bar{X})^2$ |
|---|---|---|---|---|---|
| 4 | 20 | 80 | 0.60 | 0.36 | 7.20 |
| 3 | 30 | 90 | -0.40 | 0.16 | 4.80 |
| 2 | 0 | 0 | -1.40 | 1.96 | 0.00 |
| 1 | 0 | 0 | -2.40 | 5.76 | 0.00 |
| | $\sum f = 50$ | $\sum fx = 170$ | | $\sum (X - \bar{X})^2 = 8.24$ | $\sum f (X - \bar{X})^2 = 12.00$ |

$$\bar{X}_2 = \frac{\sum FX}{\sum FX} = \frac{170}{50} = 3.40$$

$$SD_2 = \sqrt{\frac{\sum (X - \bar{X})2}{N-1}} = \sqrt{\frac{8.24}{50-1}} = \sqrt{0.17} = 0.41$$

t-calculated =

$$= \frac{\bar{X} - \bar{X}2}{\sqrt{\frac{SD_1^2}{N_1} + \frac{SD_2^2}{N_2}}} = 2.70$$

$$\frac{\bar{X} - \bar{X}2}{\sqrt{\frac{0.82}{95} + \frac{0.41}{50}}} = \frac{0.18}{0.06663} = 2.70$$

t-calculated = 2.70

**APPENDIX C**

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA,

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION.

RESEARCH QUESTIONNAIRE

MASTER CRAFTSMEN AND APPRENTICE

RESEARCH TOPIC: **Assessment of the Job Performance of Road-Side Mechanics in the Maintenance of Modern Automobile Vehicles in Minna Metropolis.**

Instruction: Please read the questions and respond appropriately. Indicate your choice with a tick

[ ✓ ]

Response options are:

Strongly Agree = SA, Agree=A,

Disagree = D, Strongly Disagree = SD

SECTION A

NAME OF AUTOMOBILE WORKSHOP…….....

……

LOCATION……

……

AUTOMOBILE ROAD-SIDE MECHANICS ☐ VEHICLE OWNERS ☐

please tick appropriately

QUESTION 1

What are the skill performances required by road side mechanics in the diagnosing faults in modern automobile?

| S/N | Items | SA | A | D | SD |
|---|---|---|---|---|---|
| 1 | Conduct engine performance test and determine needed repairs. | | | | |
| 2 | Perform an on- board computer diagnosis on Electronic Control Unit. | | | | |
| 3 | Diagnose and carry out needed repairs on multiplex electrics and wiring: signals and current flow controls. | | | | |
| 4 | Perform oil and lubrication service on normally aspirated and turbocharged engines. | | | | |
| 5 | Checking mixture regulation function via Electronic Control Unit. | | | | |
| 6 | Inspect, repair or replace electronic injection components when needed. | | | | |
| 7 | Diagnose Electronic injection system faults and determine needed repairs. | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Checking engine speed sensor function via Electronic Control Unit. | | | | |
| 9 | Checking diagnostic warning light control function via Electronic Control Unit. | | | | |
| 10 | Checking coolant temperature warning lamp function via Electronic Control Unit. | | | | |
| 11 | Use of diagnostic equipment to diagnose a faulty carburetor for adjustment and repair. | | | | |
| 12 | Use ignition timing light to check the spark advance for the ignition timing setting. | | | | |

QUESTION 2

What is the modern equipment needed by auto mechanics to achieve job satisfaction for vehicle users?

| S/N | Items | SA | A | D | SD |
|---|---|---|---|---|---|
| 13 | Tachometer | | | | |
| 14 | Cylinder compression tester | | | | |
| 15 | Cylinder leakage tester | | | | |
| 16 | Engine vacuum gauge | | | | |
| 17 | Exhaust gas analyzer | | | | |
| 18 | Ignition timing light | | | | |
| 19 | Dwell meter | | | | |
| 20 | Chassis dynamometer | | | | |
| 21 | Oscilloscope | | | | |
| 22 | Engine analyzer | | | | |
| 23 | Filler Guage | | | | |

QUESTION 3

What are the strategies that will be adopted to meet the need for job performance of auto practitioners?

| S/N | Items | SA | A | D | SD |
|---|---|---|---|---|---|
| 24 | Organizing general automobile workshop training center by Automobile Technician Association. | | | | |
| 25 | Support from state government in organizing training programme to update road-side auto mechanics performance. | | | | |
| 26 | Encouraging Vocational and Technical Institutions in the state by government to take maximum use of their available equipment and facilities for training programmes for road-side auto mechanics. | | | | |
| 27 | Provision of automobile equipment and facilities for road-side auto mechanics by the state government. | | | | |
| 28 | Employment of an expert that is updated in electronic and computer cars for the training programme of road side mechanics. | | | | |
| 29 | Accreditation modalities for road-side auto mechanics after completing training programmes through non-formal education by National Board for Technical Education. | | | | |
| 30 | Road-side auto mechanics should equip their workshop with modern equipment. | | | | |
| 31 | Encouragement from car owners in respect to workmanship charges. | | | | |
| 32 | Automobile manufacturers should organize seminars and workshop training with road-side auto mechanics. | | | | |
| 33 | Road-side auto mechanics should stay current with changes in automobiles production. | | | | |