

Assessing the Skills of Roadside Mechanics in Diagnosing and Fixing Problems of Modern Electronic Managed Vehicles in Ghana (Tamale Metropolis)

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Abstract

The paper assesses the skills of roadside mechanics in diagnosing and fixing problems of vehicle system and components in the Tamale Metropolis. In the study, the various vehicle repair and maintenance skills used by roadside mechanics were investigated using questionnaires as data collection tool. The study revealed that, a large number of the auto-mechanics in the Tamale Metropolis have considerable years of auto repair working experience, but lack the ability to inspect and repair modern electronic managed vehicles due to low educational and technical levels. The study also indicates that, the auto mechanics lack the ability to use modern diagnostic equipment, manufacturer's manuals, computers and internet which have characterized modern vehicle repairs, in their repair practices. It is recommended that, government should assist in training roadside mechanics to upgrade their knowledge and skills in the area of automotive electronics. Training institutions and organizations such as the universities, polytechnics, National Board for Small Scale Industries (NBSSI), etc., should assist particularly in the form of education and training to equip roadside mechanics with the requisite skills and technology to be able to work on the electronic managed vehicles.

Keywords: Diagnosing; Vehicle Systems; Component; Roadside; Mechanics; Assessing; Skills; Metropolis.

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1. Introduction

These days have witnessed a rapid growth of automotive industries all over the world. As the years gone by, there has been enormous technological improvement to the modern day vehicle design for it to be safer, efficient and pleasing to the customer. These call for a skillful mechanic to be able to deal with modern day vehicle design. The skills of auto mechanic are often developed contemporaneously in workshop. Practical skills referring to the ability to use tools effectively and in an efficient manner, the ability to undertake the work of the day such as brake repair, transmission rebuilding and the like, and the ability to diagnose problems associated with repair of automotive vehicles [6].

According to [18], roadside mechanics acquire skills but these practical skills only involved assembling of parts. These practical skills are mostly devoid of diagnostic skills and knowledge information. Because of this deficiency, apprentices were hardly able to perform any operations that are new to them, except those they have seen their master carry out. In the practice of skills, the recipients observe the master trainer perform the operations, and through imitation, the apprentices then practice the skills until they become proficient in them. Reference [13] indicated that productivity was low in automotive workshops in Bangladesh as the service was rendered by hands. Tools and equipment used were mostly outdated and these affected their ability to work on complex systems especially electronic and automatic transmission systems. He further found that abundant labor is available in Bangladesh and as such all of these workshops used labor intensive technology.

The study conducted by [16] showed that working experience or number of years spent with master craftsman affects the skills acquired by apprentice. To become a master craftsman, you need to have strong practical skills. You need to be good at problem-solving and faults detection. You also need to have good human relations and great customer service skills. The Internet is even spreading to mechanics, with certified mechanics providing advice online. Mechanics themselves now regularly use the Internet for information to help them in diagnosing and/or repairing vehicles. Service manuals for vehicles have become significantly less prevalent with computers that are connected to the Internet taking their position [11]. In repairing cars, the main role of the mechanic is to diagnose the problem accurately and quickly. They often have difficulty in diagnosing electronic faults. Study shows that their job may involve the repair of a specific part or the replacement of one or more parts as assemblies [9]. Roadside mechanics have to compete with large companies which use expensive diagnostic equipment and have advantages in purchasing, distribution and marketing. Small companies can compete effectively by providing superior customer service or offering specialized services [5].

Reference [12] discovered from a skill gap analysis that majority of the mechanics in Nigeria lack the relevant knowledge about vehicle electrical and electronic components repair. Technology in the auto sector advances continually at a very fast pace. Most cars on our roads today are built with a lot of electronically controlled systems. The only way to catch up with this advancement is training and re-training. According to [13] in the past few years, the auto industry in India has seen major changes in designs and special features, and keeping these cars maintained and on the road takes highly skilled technicians and mechanics to diagnose and fix problems. Mechanics are responsible for inspecting, repairing and maintaining cars, buses, trucks, motorcycles and other vehicles. In recent years, the systems and components of these vehicles have become more complex.

However, mechanics lack the skills to work not only with special tools and diagnostic equipment, but also with sophisticated electronics and computer systems [9].

Roadside mechanics play important role in the socio-economic development of Ghana. They provide services to car owners to make their cars roadworthy. Since most vehicles are now being manufactured and controlled by modern technology, it takes a skillful auto mechanic to properly diagnose and fix problems associated with vehicles. According to [13] in the past few years, the auto industry has seen major changes in designs and special features, and keeping these cars maintained and on the road takes highly skilled technicians and mechanics to diagnose and fix problems.

Unfortunately there seems to be inadequate mechanics who are experts in carrying out the right diagnosis which can save automotive owner's time and potentially a substantial amount of money. Few studies have been carried out to assess the skills of roadside mechanics. The few studies that were conducted in Ghana [7], [1], [2] did not include Tamale Metropolis, even though a good number of roadside mechanics can be found in Tamale. It has therefore become imperative to assess the skills of the roadside mechanics in the Tamale Metropolis in diagnosing and fixing problems of vehicle systems and components.

1.1 Research questions

In conducting a study that looks at the skills in diagnosing and fixing problems of vehicle systems and components, the researchers intends to find answers to this question:

1. What are the skills needed by roadside mechanics to properly diagnose and fix problems of modern electronic managed vehicles?

2. Literature Review

The use of automotive vehicles on our roads plays a key role in road transportation system. In Ghana where land transport is largely in use compared to water, air as well as other modes of transportation. A continuous use of vehicle results in general wear, tear and breakdowns and as the parts breakdown and wear out, so, must be maintained. When something is maintained, the idea is to keep it in a good and functional state. Vehicle maintenance refers to a practice where an automotive is serviced on a regular basis to prevent a major breakdown or the need for major repair. Examples of the type of auto services that may be sought for maintenance purposes include changing the oil, changing the spark plugs, and rotating the tires. It is believed that an automotive vehicle will last longer and operate better if a person adheres to the vehicle maintenance schedule [1].

2.1 Skills requirements of roadside mechanics

Motor vehicles which were manually operated some centuries back are now electro-mechanically operated. Computers are common place in modern day automotive design; braking, steering, starting and suspensions system are few examples of items now technologically operated. Automotive technology has been evolving

since the turn of the century. Reference [15] stated that during the period from 1930 to 1970, the main body of automotive technology was mechanical they were relatively simple for any roadside mechanic to repair. By the early 1980's the introduction of information technology in automotive has triggered the most rapid technological advancement in the automotive industry. With the computers available, automotive designers have developed numerous sensors and controls. Now computers have even been used as components parts for brakes, steering, chassis systems and other parts of automobile. Technologies have recently been incorporated in all new automotive subsystems and have become standard implementation on many others. Such features as antilock braking system and airbag could only be achieved practically through the use of technology. These features are rapidly becoming standard features in all new automotive owing to change in customer's taste for automotive and status symbols attached to car ownership. All these systems require maintenance and repairs. The competencies required to maintain automotive of the 1900,s show little similarity with the competency required of the 1970s. Around 1970,s and 1980,s roadside mechanics used what is termed the 'try and error' to repair almost all automotive vehicles [27]. Rapid development of automotive technology has presented some challenging problems for roadside mechanics in the country. Reference [23] noted that the use of scan tools like On-Board Diagnostic, One, Two and Three (OBDI, OBDII, and OBDIII) are common place in the repair of automotive in the manufacturer's approved service centers today. The on-board diagnostic (OBD) is an automotive term referring to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle repairer access to the status of the various vehicle sub-systems and give the mechanic a clue as to where to look at when a problem occurs on the vehicle. But for one to be able to use this tool the mechanic must be able to understand the principles behind its usage [7].

The US Department of Labor Statistics estimated that due to the increasing average lifespan of cars and growth in the number of cars being driven, the department projected the demand for automotive mechanics to increase 9% between 2012 and 2022. Those with specialized knowledge or training will have the best opportunities. The rate of change in technology is exponentially increasing. Nations, industries, and individuals must develop their capabilities to keep abreast of technological changes and to harness technology. Automotive workshops are category of small industry that contributes to the maintenance of vehicles. The repairing workshop plays an important role in the economy of every nation through maintaining motor vehicles in an efficient manner which helps in making transport services more efficient. Automotive workshops and repair shops can be divided into several categories. A majority of automobile repair workshops are independently owned and operated businesses [13].

In Ghana, most of the vehicle maintenance and repair jobs are performed by roadside mechanics, this research seeks to assess the skills of the mechanics in the advent of automotive technology advancement and the opportunities available to these roadside mechanics so as to prevent them from becoming career disabled due to increase in vehicle technology. The Motor Vehicle Repair and Service Industry (MVRSI) is a thriving industry, with several small open-air garages in towns across Kenya [33]. With increasing technical sophistication, the human resource in the MVRSI requires continuous development of technical and interpersonal skills necessary for them to remain relevant in their practice. Reference [6] advanced three reasons for the importance of technical training: changes in administrative structures, technological advancement and tougher occupational health and safety laws. He provides an example of a vehicle repair mechanic who has to undertake extensive

ongoing training to maintain and fix the latest models of cars with computer-operated parts, keyless entry, global positioning systems, automated stabilizing systems, and other related inventions. In Kenya, Reference [34] observed that most Vocational Education and Training (VET) institutions used very old models of vehicle engines for their automotive practical training. Thus, the graduates are confronted with challenges at the workplace because their training is not aligned to the technological know-how required for the industry.

Today, non-formal apprenticeship programs are provided in many areas such as tailoring, hair weaving and iron bending, carpentry, brick laying, auto-mechanics, auto-body repairing, air conditioner maintenance, tire vulcanizing, electrical installing, furniture making, welding/ fabrication, sheet metal work, machining (turning), fitting and foundry work and so on. An important component of the non-formal apprenticeship programs in Nigeria is that a contract agreement is entered into between the master craftsman and the apprentice. Such contractual agreement incorporates the fee payable by the apprentice and the period of training. Also spelt out is the penalty when either party breaks the contract. Reference [18] stated that the set-up for the training workshop involves the master craftsman (trainer), and the apprentice (trainee). The master craftsman has full control of the workshop. The roadside workshops are organized along the line of the master/apprentice situation, where the master craftsman owns all the tools, workshops and skills from which the apprentices benefit. According to [26] they often illiterate or semi-illiterate master models develop training programs lacking basic theoretical concepts. Although local tradesmen may function successfully in the labor market, they remain in the final analysis in the lower cadre of manpower personnel and their practical expertise degenerates into mechanical manipulation.

The roadside apprentice program has contributed immensely to the Nigerian economy. It has provided training opportunities to many Nigerians who would have become social nuisances to the public. It has become an indispensable complement to formal education. However, the contribution the roadside apprenticeship is making to the national economy is high; leaving the master craftsman to control the training situation of the apprentice seems to place too much responsibility on that person. The Federal Republic of Nigeria's realization of the importance of the roadside apprenticeship can be seen in its policy which states that "the question of accreditation for roadside mechanics and others who complete training programs through non-formal education will be undertaken by the National Board for Technical Education (NBTE)". It is more than three decades since this policy was promulgated, but no roadside mechanic has been accredited, and there is no plan for implementing the policy. Also, there have not been any objective statements written for these apprentice programs [18].

Apprenticeship training leads to the acquisition of skills as well as basic scientific knowledge. It is a planned program and learning experiences that begins with exploration of career options, supports basic life skills, and enables achievement of high preparation for industry-defined work, and advanced and continuing education [14]. Vocational education is a practical instruction that gives learners specific occupational skills. Thus vocational education and training prepares learners for careers that are based in manual activities and traditionally non-academic that relate to a trade, occupation or vocation. Specifically, vocational and technical education gives individuals the skills to learn and become productive citizens and for advancement in the workplace [24]. Some scholars perceive technical and vocational education as one of the "bulwarks of social

efficiency” as the preparation of a well-trained workforce [30]. And because of the unrelenting changes in the new global economy one may not be relevant in the labor market in future without a certain level of technical skills. The neglect of vocational and technical education in Nigeria leads to the dearth of skilled technical manpower to maintain the nation’s critical infrastructure and to tackle its developmental challenges [28].

Automotive service technicians and mechanics could use high-tech skills to inspect, maintain, and repair heavy duty automotive and light trucks with gasoline engines. The increasing sophistication of automotive technology now relies on workers who can use computerized shop equipment and work with electronic components, while maintaining their skills with traditional hand tools. Because of these changes in the occupation, workers are increasingly called "automotive service technicians," and the title "mechanic" is being used less and less frequently.

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components of these vehicles have become more complex. However, mechanics lack the skills to work not only with special tools and diagnostic equipment, but also with sophisticated electronics and computer systems [9].

Innovations in the automotive industry have gradually transformed what it means to be an auto repair worker. As the cars on our streets have become more computerized, so, too, has the job of maintaining and fixing these vehicles. And so a trade that was once largely mechanical is today primarily technical, and therefore requires workers to be skilled computer users, strong readers and able mathematicians. According to [25] the skills of an auto mechanic will vary greatly. Some mechanics develop the skills to work on all parts of a vehicle, while others choose to specialize in a particular field. He father said that a competent car mechanic should also have mastery over a wide variety of integrated skills, such as the electrical system, fuel system, and the air conditioning system. Computer skills are also needed in the day-to-day operations, and are as much a part of the tool box as wrenches. As knowledge is gained, it becomes easier to move into higher paying positions.

As time goes on, many older master craft men may be out of business because they don't possess the computer skills necessary to work on modern cars and also impact knowledge on the aspiring auto mechanics of today. With additional skills, it's easy to gain employment.

2.2 Facilitation of acquisition of skills in Ghana

The government of Ghana through the Ministry of Local Government and Rural Development established the Local Enterprises and skills Development Program (LESDEP) as a public-private partnership in April, 2011. LESDEP has successfully opened offices in all 170 Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana with the sole objective of creating and facilitating the acquisition of technical, entrepreneurial and other specialized skills that will lead to the creation and management of sustainable businesses by the unemployed youth in the country, and providing start-up equipment and post-set-up support services to micro and small enterprises in Ghana [22]. Laudable as the interventions are, studies still show that up to 50% of the small-scale businesses in operation in developing countries including Ghana have a deteriorating performance and are stagnant at the micro and small-scale levels without progressively growing into medium or large-scale enterprises [31]. In Ghana, it is earlier estimated that 25 to 30% of micro and small-scale enterprises [MSEs] fewer than five years collapse annually. Ghana is experiencing an increasing vehicular population. For instance, in 1996, the total number of vehicle registered with Driver Vehicle and licensing Authority (DVLA) in Ghana stood at 27,064, excluding an estimated 29,845 government vehicles and others not presented for the bi-annual roadworthy test. This figure rose to 52,881 vehicles in 2000 and as at 2010, the vehicular population in Ghana stood at 771,594 [29]. As at March 2012, the total vehicle population in Ghana stood at approximately 1,425,900 [3]. This has resulted in the increase demand for the service of vehicle repair garages accordingly. In the US, these shops are the only individuals authorized to perform warranty and recall repairs by the manufacturers and distributors. In the European Union a recent law allows motorists more flexibility in selecting where they can get their car serviced [21].

The development of physical infrastructure not only accelerates the pace of economic growth of the country but also firmly supports the development of social and other sectors. Transport occupies the lead position among

physical infrastructures. The development of transport directly influences the development of both productive and social sectors, the former represented by agriculture, industry, commerce, etc, and the latter represented by education, health, etc. Taking this reality into consideration, special attention has to be given to the development of the transport sector from the very beginning of the planned development.

2.3 Vocational Skills and Training

According to the [19] study on vocational education and training in developing countries shows that, entry into self-employment in the lower tier of the informal sector (both urban and rural) requires few skills. Those that are required are easily learned informally. In upper-tier enterprises, however, especially those in manufacturing and repair, higher skill levels are essential. The skills required in the informal sector are different from those required in modern sector workplaces is hardly surprising. On the other hand, there is the surprising possibility that informal sector workers may need an even more demanding set of skills as the smallness of microenterprises compels workers to regularly perform a wide range of technical and business tasks. In West Africa, traditional apprenticeship is the most common means of skill acquisition for informal sector workers: "a remarkable blend of work, practical training and moral upbringing is the main avenue to self-employment in micro-enterprises and thus a cornerstone of informal sector development" [35]. In Ghana, for example, it has been estimated that approximately 55% of informal sector workers learned their skills from informal apprenticeships [20]. The first problem in the skill acquisition process is under-investment by all stakeholders. This is because the cost of skill acquisition exceeds the benefit to any single stakeholder. Since the benefits of skill acquisition do not accrue exclusively to the trainees, we could view training as a public good and formulate the unwillingness to invest in skill acquisition or the under-provision of training as the free-rider problem [32].

3. Methodology

Survey research design was used. Survey research method has the ability to produce statistics, that is quantitative or numerical descriptive about some aspects of the study population [8]. Generally, a survey research method also allows the researcher to collect data from a fraction of the population. That is, a sample, rather than from every member of the population. This design was used in order to conduct accurate investigation in to skills needed by roadside mechanics in diagnosing and fixing problems of automotive components and systems. This particular design was applied by the researcher because it is only a part of the population that is going to be studied. Information was obtained from a sample rather than the entire population. This ranged from one day to a few weeks. Descriptive survey research collects data in order to answer questions covering the current status of the subject in the study. It also allows for quick collection at comparatively cheap cost.

3.1 Population

The study was conducted in the Tamale Metropolis in the Northern Region of Ghana. The population of auto workshops in the Tamale Metropolis is about one hundred and two (102). Out of the number 64 are members of Ghana national Association of Garages, Tamale Zone [10]. The other thirty eight [38] were not registered with

any association (Field data, 2016). Also number of registered vehicles in the Tamale Metropolis as at 2015 was about nine thousand (9,000) [3]. Out of the 102 auto workshops, eighty master craft men from eighty workshops were selected. This constituted the sample for the study, which was based on the willingness of the mechanics to be part of the study. All the selected master craft men in the sample were issued with questionnaire developed. Majority of the master craft men were located in the industrial area as well as other locations in the Tamale Metropolis.

3.2 Sample and sampling procedure

The researcher realized that the population of the roadside mechanics in the Tamale Metropolis was too large if everybody is to be considered; therefore a simple random sampling was used. According to [14], simple random sampling is the best method for selecting a sample from a population of interest. This procedure selects a sample without bias from the population. It also ensures that each member of the population had an equal and independent chance of being included in the sample.

3.3 Instruments used

The researcher use questionnaires in order to give detailed level of content. According to [4], questionnaire is a reliable instrument for data collection. The questionnaire contains preamble and two sections A and B. Section A contains information on personal details of roadside mechanics. Section B contains information about Skills needed by roadside mechanics to diagnose and fix problems of vehicle systems and components. Questionnaires were administered to respondents because the method yields high response rate at low cost and enables the researcher to explain and answer questions from the respondents. Respondents were expected to react to the statements by either agreeing or disagreeing with them. Whereas '5' represented a strong agreement, '1' represented a strong disagreement. Where a respondent could not read or write the researcher interpreted the statements and helped to fill in their responses on the questionnaire.

3.4 Reliability of Instrument

The reliability of the instrument was obtained by testing the questionnaire. The data collected were subjected to Cronbach Alpha reliability test using Statistical Package for Social Science [SPSS] which had a computed Cronbach Alpha of 0.837 indicating that, the statements were reliable. Also the pre- testing of questionnaire was conducted with 10 master craftsmen. They were selected randomly from the Metropolis. These respondents were not part of the actual sample of the study. Respondents were encouraged to make useful suggestions.

3.5 Data collection procedure

The researcher visited the workshops, introduced his topic and explained the assistance needed from them. The questionnaires were explained to the master-craftsmen and their clients and they were helped to fill the questionnaires. The researcher also came to consensus with the respondents about the time limit for filling the questionnaires. Once the time limit reached, the researcher collected the questionnaires from the master-craftsmen for data analysis.

3.6 Methods of data analysis

Descriptive statistics was used to analyze the data. According to [17], descriptive statistics helps to simplify large amount of data in a sensible way. It reduces lot of data into a simpler summary. Percentages and proportions were applied to establish the skills needed in diagnosing and fixing problems of vehicle systems and components. To enhance understanding of the findings, tables were used.

4. Presentation of Results

The data collected on the demographic characteristics such as age, educational level, and working experience of the sample were analyzed using the Statistical Package for Social Science [SPSS].

Table 1: Cross Tabulation of Age and Highest Education of roadside Mechanics

Age	Highest Education				Total
	None	Basic	Secondary/Technical	Tertiary	
Below 20 yrs	1	3	0	0	4
21-30 yrs	5	1	6	3	15
31-40 yrs	8	5	10	5	28
41-50 yrs	10	6	8	1	25
51-60 yrs	2	3	0	1	6
61 and above	2	0	0	0	2
Total	28	18	24	10	80

Source: Field Data 2017

Table 1 reports the data collected from the 80 respondents, who were mainly master craft men of vehicle repair garages in the Tamale Metropolis, on their age and level of education. The table revealed that, a good number of the roadside mechanics twenty-eight (28) representing 35% have no formal education which cut across all the age groups. The remaining 65% have one form of formal education or another. Twenty- two point five percent (22.5%) representing 18 roadside mechanics have basic education, thirty percent (30%) representing 24 roadside mechanics have secondary/ technical education and the remaining ten (10) roadside mechanics representing 12.5% have tertiary education. Table 1, further revealed that, the age group which has the highest level of

education was between ages 31-40yrs. Cumulatively, this age group 31-40yrs has a total of twenty (20) roadside mechanics representing 25% who have formal education from basic to tertiary. The mechanics with the age group 60 and above has no formal education at all levels.

Table 2: Cross Tabulation of Age and Number of Years in Auto Industry

How long in auto industry						
Age	Below 5 yrs	6-15 yrs	16-25 yrs	26-35 yrs	36-45 yrs	Total
Below 20 yrs	4	0	0	0	0	4
21-30 yrs	0	14	1	0	0	15
31-40 yrs	0	14	9	4	1	28
41-50 yrs	0	2	13	6	3	24
51-60 yrs	0	2	0	3	2	7
61 and above	0	0	0	1	1	2
Total	4	32	23	14	7	80

Source: Field Data 2017

Table 2 reports that, a large proportion of the roadside mechanics twenty-eight (28) representing 35% whose ages are between 31-40yrs have the greater years of working experience. Unfortunately, it's noticed that, roadside mechanics with the age group of 60 and above years who are supposed to have more working experience are not many. Cumulatively, they are only two (2) representing 2.5% of the roadside mechanics who are still actively practicing automotive repair works. Again, a large number (32) of the roadside mechanics representing 40% with ages between 21-61yes and above have between 6-15 years working experience. A total of (24) roadside mechanics whose ages are between 41-50 years have between 6-45 years working experience.

Table 3 revealed that, almost all (92.5%) the master craft men in the Tamale Metropolis strongly agreed or agreed that, they can carry out engine tune- up accurately while 3.8% were in disagreement. The study found that, on the issue of timing injection pump to engine 98.8% of the respondents which forms the majority strongly agreed or agreed to the statement but none of them strongly disagreed. More than half (65%) of the master craft men strongly agreed that they can time valves accurately to an engine only small proportion (1.2%) of the mechanics disagreed. Furthermore, on the area of calibrating injection pumps 71.3% of the entrepreneurs

of vehicle repair garages in the Tamale Metropolis strongly agreed or agreed that, they have the necessary skills to calibrate an injection pump. Ten percent remains neutral and 6.2 % strongly disagreed. On ignition timing more than half (53.8%) of the mechanics, strongly agreed or agreed that, they have the needed skills to perform ignition timing accurately. However, 66.2% strongly agreed or agreed that, they have the ability to fix problems on single point petrol injection system. Almost half (42.5%) of the master craft men of vehicle repair garages in the Tamale Metropolis agreed that they can fix problems on multi-point fuel injection system. Majority (82.5%) of the master craft men of vehicle repair garages in the Tamale Metropolis strongly agreed that they have the skills of overhauling an engine, only 5% strongly disagreed to the statement.

Table 3: Skills Requirements of Roadside Mechanics

Skills of Roadside Mechanics	Percentage					Mean	S.E
	1	2	3	4	5		
6. I have the skill in performing engine tune-up accurately	3.8	3.7	0	30	62.5	4.44	0.11
7. I time injection pumps to engines accurately in the shop	0	5	1.2	35	58.8	4.48	0.09
8. I have the skill in timing valves to an engine accurately	0	1.2	1.2	32.5	65	4.61	0.07
9. I am able to calibrate fuel injection pump accurately	6.2	12.5	10	33.8	37.5	3.84	0.14
10. I have the skill in performing ignition timing accurately	2.5	2.5	5	36.2	53.8	4.36	0.1
11. I fix problems on single point fuel injection systems	6.3	12.5	15	36.2	30	3.71	0.13
12. I fix problems on multi point fuel injection systems	5	10	15	42.5	27.5	3.78	0.12
13. I am able to overhaul an engine	3.8	2.5	0	11.2	82.5	4.66	0.1
14. I have the skill in performing phase angle test accurately	13.8	22.5	16.2	28.8	18.8	3.16	0.15
15. I have the skill in working on lubrication systems	2.5	3.8	2.5	31.2	60	4.43	0.1
16. I have the skill in repairing air braking systems	6.2	10	5	42.5	36.2	3.93	0.13
17. I am able to fix problems in servo assisted hydraulic system	6.2	16.2	5	31.2	41.2	3.85	0.14
18. I fix problems on generating(alternator) systems	18.8	31.2	7.5	25	17.5	2.91	0.16
19. I install sensors in the engine management system	13.8	28.8	18.8	23.8	15	2.98	0.15
20. I fix problems on manual transmission systems	5	15	11.2	35	33.8	3.78	0.14
21. I fix problems on automatic transmission systems	18.8	23.8	12.5	28.8	16.2	3	0.16
22. I have the skill in using scan tool for diagnosis	35	26.2	7.5	17.5	13.8	2.49	0.16
23. I have the skill in fixing problems on water cooling systems	1.2	6.2	6.2	41.2	45	4.23	0.1
24. I have the skill in fixing problems on air cooling systems	3.8	13.8	5	42.5	35	3.91	0.13
25. I fix problems on vehicle suspension systems accurately	1.2	8.8	7.5	30	52.5	4.24	0.11

Note: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree

Source: Field data 2017

The study also revealed that less than half (47.6%) of the roadside mechanics in the Tamale Metropolis can

perform phase angle test accurately. Furthermore, it is observed from Table 3 that the majority (60%) of the master craft men of vehicle repair garages in the Tamale Metropolis strongly agreed that they have the skill in fixing problems of vehicle lubrication system accurately.

Only 6.3% strongly disagreed or disagreed to the statement. The study indicated that, almost half (42.5%) of the respondents of vehicle repair garages in the Tamale Metropolis agreed that they have the technical competence to work on vehicle braking system.

Also, on the issue of generating system half (50%) of the respondents strongly disagreed or disagreed that they have the skill in fixing problems of vehicle generating system while 17% of the entrepreneurs strongly agreed to the statement. Furthermore, with Installation of sensors in the engine management system almost half (42.6%) of the respondents of vehicle repair garages in the Tamale Metropolis strongly disagreed or disagreed that they have the skills in installing sensors in the engine management system.

Fifteen percent (15%) strongly agreed and 13.8% strongly disagreed. Also, more than half (68.8%) of the respondents are of the view that they have the skills to fix problems on manual transmission systems but 5% strongly disagreed.

On the area of automatic transmission systems less than half (45%) of the mechanics of vehicle repair garages in the Tamale Metropolis strongly agreed or agreed that they can fix problems on automatic transmission systems 12.5% remains neutral.

On scan tool diagnosis, 61.2% of the entrepreneurs of vehicle repair garages in the Tamale Metropolis strongly disagreed or disagreed that they can use scan tool for diagnosis and only 13.8% strongly agreed to the statement.

Majority (86.2%) of the master craft men in the Tamale Metropolis endorsed that they have the skills in fixing problems on water cooling system while 76.5%. strongly agreed or agreed that they have the skills in fixing problems on air cooled engines. In the case of vehicle suspension system majority of the master craft men representing 82.5% strongly agreed or agreed that they have the skills to adequately fix problems on vehicle suspension system.

Table 4 reports the correlation matrix of some skills possessed by roadside mechanics in the Tamale Metropolis. It is observed that mechanics who possessed the skills of engine tune- up also have the skill in timing injection pumps to engine ($r = 0.73$, $P < 0.01$).

It can be seen that mechanics who can perform ignition timing can equally carry out valve timing ($r = 0.47$, $P < 0.01$). The roadside mechanics also believe that if you can carry out overhauling then you can equally perform valve timing. ($r = 0.32$, $P < 0.01$).

Table 4: Correlation Matrix of Skills of Roadside Mechanics

	1	2	3	4	5	6	7	8	9	10
1. Engine tune – up accurately	1									
2. Time injection pumps to engines	0.73 ^a	1								
3 Timing valves to engine accurately	0.35 ^b	0.42 ^a	1							
4. Calibrate fuel injection pump accurately	0.13	0.22 ^b	0.42 ^a	1						
5. Performing ignition timing accurately	0.10	0.27 ^b	0.47 ^a	0.48 ^a	1					
6. Fix problems on single point fuel injection	0.22 ^b	0.36 ^a	0.27 ^b	0.27 ^b	0.49 ^a	1				
7. Fix problems on multi point fuel injection	0.05	0.22 ^b	0.21	0.3 ^a	0.45 ^a	0.83 ^a	1			
8. Overhaul an engine	0.47 ^a	0.25 ^b	0.32 ^a	0.05	0.02	0.19	0.15 ^b	1		
9. Performing phase angle test accurately	0.16	0.20	0.34 ^a	0.60 ^a	0.31 ^a	0.25 ^b	0.28 ^a	0.06	1	
10. Working on lubrication systems	0.29 ^a	0.13	0.39 ^a	0.30 ^a	0.12	0.45	0.14 ^b	0.24	0.2	1

^aP<0.01

^bP<0.05

Source: Field Data 2017

5. Discussions of Result

As shown in Table 2 a good number of the auto mechanics in the Tamale Metropolis have over 10 years of working experience, indicating that they possess enough experience in repair and maintenance of automotive vehicles. However, despite their vast experience in automotive repair practices, most of the mechanics in the Tamale Metropolis find it difficult to diagnose and repair modern automotive vehicles using scan tools, especially modern electronic managed engines, automatic transmission systems, engine management system, steering system as well as charging system. The mechanics inability to repair and maintain modern automotive vehicles could be largely attributed to their low levels of education. As indicated in Table 1, over 35% of auto mechanics in the in the Tamale Metropolis do not have education at all. About twenty three percent (23%) possess basic education, 30% for technical/ secondary and only 12.5% were up to tertiary level. This low level of education of the auto mechanics in the Tamale Metropolis has caused a major setback in that most of them

are ignorant and not quite familiar with the advancing technological know-how of the trade. Some of them cannot read and write, and so find it difficult referring to instruction manuals, which has rather characterize modern auto repair practices. Again, the mechanics low levels of education have resulted in situation where most of them find it extremely difficult identifying the components of modern electronic engines by their technical names correctly. Moreover, from observations, apart from possessing low educational levels, a very large number of the auto mechanics in the Tamale Metropolis do not have knowledge in computer skills which are pre-requisites for repairing modern automotive vehicles. However, modern practices of automotive vehicle faults diagnosis, repair and maintenance require highly trained mechanics. The job of an auto mechanic has become increasingly specialized in the 21st century. With the rapid advancement in technology, the mechanic's job has evolved from purely mechanical, to include electromechanical technology. Because vehicles today possess complex computer and electronic systems, mechanics need to have a broader base of knowledge than in the past. This goes to affirm the accession of [15] who stated that during the period from 1930 to 1970, the main body of automotive technology was mechanical they were relatively simple for any roadside mechanic to repair. By the early 1980's the introduction of information technology into the automotive industry has triggered the most rapid technological advancement in the automotive industry. Fully skilled modern automotive repairers must have good reading ability and computer skills. Restoring automotive to their original form, state and working condition requires mechanics to follow instructions and diagrams in technical manuals. The internet is even spreading to mechanics, with certified mechanics providing advice online. Some mechanics now regularly use the internet for information to help them in diagnosing and/or repairing vehicles. Service manuals for vehicles have become significantly less prevalent with computers that are connected to the internet taking their position. It is therefore incumbent on the auto-mechanics in the Tamale Metropolis to keep updating and upgrading their technical competencies and skills in order to enable them to continually develop the capability to inspect and repair modern automotive vehicle without being kicked out of business due to technological advancements.

From Table 3, the mechanics seems to be content with their current inadequate skills levels just because they have the capability to maintain some components and systems of some vehicles, especially the old models of vehicles in the Metropolis but they still lack the skills for repair of modern electronic vehicles. Occasionally, the few well-endowed garages in the country such as Toyota Ghana, Japan Motors and others do well to organize in-service training in the form of conferences, workshops, seminars, symposia, etc., for the garages in the country. This is to enable the less endowed garages in the Tamale Metropolis to update and upgrade their technical competencies and to keep abreast with current best auto repair practices. Unfortunately, however, an informal interview with some of the master craft men in the Tamale Metropolis reveals that they hardly take advantage of these training programs to upgrade their skills due to lack of time and sometimes the minimum training cost involved. Moreover, to become proficient in a complex specialty such as automotive air-conditioning, electronic engine management systems, automatic transmission repairs as well as other similar specialty repairs might require another year or two of training or on the job experience.

6. Conclusion

In this paper, the skills of roadside mechanics in the Tamale Metropolis have been assessed. Automotive vehicle

repair workshops help to maintain the vehicles on the roads. Currently, most of the vehicle repair garages in the Tamale Metropolis are faced with numerous challenges including: Lack of skills to repair modern electronic vehicles, low capital and infrastructure base, inability to acquire and use modern vehicle diagnostic equipment and tools, low educational levels, lack of training and re-training, inability to use computers and internet facilities for vehicle repairs. The days of being only mechanically inclined are gone for most roadside mechanics. Now the general engineering mechanic and roadside mechanics or diagnosticians must be able to understand and appreciate the use of technology as a business tool. Once the mechanic understands how the technology behaves, the vehicle of today will not be complicated to repair as they may think. If roadside mechanics in the Tamale Metropolis fails to adapt to technological changes and advance accordingly, Ghana will lose competent mechanics some few years to come because of their inability to convert or adapt technological changes to modern methods.

Again, it could be concluded that the practices of the automotive repair services in the Tamale Metropolis could be improved by giving the master craft men the needed professional training and also adequately resourcing them in terms of modern equipment and logistics.

7. Recommendations

Based on the findings and conclusions drawn from this study, the following recommendations are put forward to help the automotive repair garages to operate at competitive advantage.

1. In order to meet the increasing demand of after sales service, the dealership service garages need to work in collaboration with the roadside mechanics.
2. Roadside mechanics also contribute to economic growth of the country so; they should be giving every opportunity to undergo a series of training to upgrade their technical knowledge in the use of diagnostics tools and basic vehicle electronics training through the Skills Development Fund (SDF) initiative.
3. A government subsidy given to roadside mechanics to upgrade their knowledge in their trade area is likely to bring more benefits in terms of employment generation.
4. The GSDI (Ghana Skills Development Initiative) programme should be extended to cover more mechanics in the Tamale metropolis
5. Again, there are also training and in-service training programs available on the internet to enable mechanics to become proficient in their auto repair practices. Indeed, education and training is a lifelong process. The mechanics in the Tamale Metropolis should see re-training programs as fundamental to their sustenance and survival in the current auto repair industry. They should therefore take advantage of the training programs offered by the aforementioned organizations in the country to continually polish their skills.

References

- [1] Apakpavi, M. (2014). Modern Automobile Vehicle Repair Practices in Micro, Small and medium Scale

- Garages in Ghana International Journal of Science, Technology and Society. 2(6).216-222.
- [2] Agebure, A. B. (2014). An Investigation into the Management of Vehicle Repair Garages in the Bolgatanga Municipality of Ghana. *European Journal of Business and Management*. vol.6(32);25-49
- [3] Addison, T. (2015). Vehicle Population and International Trend. Ministry for transport (Ghana Government).
- [4] Annum, G. (2015). Research Instruments for data collection. Kwame Nkurumah University for Science and Technology. KNUST. Gh.
- [5] Auto repair Business and Trends, (2012). Auto repair Business Industry summary. Bureau of Labour statistics USA.
- [6] Barber, J. (2003). 'The informally trained mechanic: Skill acquisition in the workplace'. *Journal of Vocational Education and Training*, 55(2), 133-148.
- [7] Edunyah, I. (2015). Technology and Modern Automobile Industry-Challenges and Opportunities for Roadside Mechanics in Ghana. (TarkwaNsueam Municipality). *International Journal of Scientific Research and Innovative Technology*, 2(6), 58-63.
- [8] Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2011). *Survey methodology* (Vol. 561). John Wiley & Sons.
- [9] Funkhouser, J. (2013). How innovation has changed the job of auto repair technician. *Washington Post*.
- [10] Ghana National Association of Garages Tamale Zone (2016).
- [11] Jeffrey, N. R. (2015). 40-millionth Toyota Corolla ever built. *Autoblog.com*. Retrieved 2015-02-17.
- [12] Jalal, D. (2013). enhance capacity building in line with the approved National Automotive Industry Development Plan. Nigeria: Houton best new.
- [13] Kayemuddin, M., & Kayum, S. (2013). Problems and prospects of automobile workshops in Bangladesh. *Journal of African Studies and Development*, 5(6), 157.
- [14] McLeod, S. A. (2014). Sampling Methods. Retrieved from www.simplypsychology.org/samplig.html
- [15] Santini, A. (2004). *automotive electronic* 2nd edition. Glen Ellyn, Illinois: Cengage Learning. pp.544.
- [16] Sambo, M. N., Idris, S. H., & Shamang, A. (2012). Determinants of occupational health hazards among roadside automobile mechanics in Zaria, North Western Nigeria. *Borno Medical Journal*, 9(1), 5-9.

- [17] Trochim, W. (2006). Descriptive statistics in research Methods Knowledge base (Analysis Descriptive Statistics) Retrieved from <http://www.socialresearchmethods.net/kb/statistics>.
- [18] Uwameiye, R. & Omofonmwan, G. (2014). The perceived objectives of roadside mechanic apprenticeship programs in mid-western Nigeria. *Australian Journal of Adult Learning*. vol.44(1)86-90.
- [19] World Bank, (1994). Senegal: Private Sector Assessment. Industry and Energy Division, Western Africa Department, Washington, DC.
- [20] World Bank, (1995). Apprenticeship Contracts, Small Enterprises and Credit markets in Ghana: World Bank Economic Review.
- [21] The E.C. Block Exemption Regulation (2003). Independent garages and the Motor Vehicle Block Exemption. UK Government.
- [22] The government of Ghana, (2013). Local Enterprises and skills Development Programme (LESDEP). Ministry of Local Government and Rural Development. Ministry of Trade and Industry Ghana,
- [23] Ribbens, W. B. (2003). understanding automotive electronics fifth edition. New York: Elsevier Science .pp.470.
- [24] Oni, C. S. (2006). Vocationalism in Nigerian Education. *Journal of Social Science*, 12(2): 147-150.
- [25] Otis, K. (2007). Skills Every Auto Mechanic Should Have. Wyo Tech.
- [26] Okogba, F.I. (1991). Vocational education and the informal system. *Nigerian Vocational Journal*, 2(4) 1-6.
- [27] Lindsay, C. (2013). How car will get more helpful. Available on: www.autocar.com. Retrieved from www.autocar.com.
- [28] Dike, V.E. (2009). Addressing youth unemployment and poverty in Nigeria: A call for action not Rhetoric, *Journal of Sustainable Development in Africa*. vol.11(3): 129-150.
- [29] Driver Vehicle and Licensing Authority [DVLA], (2013). Total Number of Vehicles Registered in Ghana by Categories (2000-2010), vehicles.registered-ghana-category.
- [30] Camp, W. G. (1983). Social efficiency and vocational education: An examination of our changing philosophies. *Journal of Vocational Education Research* 8(3), 10-19.
- [31] Bowen, M., Morara, M., & Mureithi, S. (2009). Management of business challenges among small and micro enterprises in Nairobi-Kenya. *KCA Journal of Business Management*. 2(1):45-60

- [32] Athena infonomicsindia, (2013). Skill Development in India Challenges and Opportunities. Athenainfonomics.
- [33] Kinyanjui M. N. (2000). Tappingopportunities in jua kali enterprises clusters: The case of Ziwani and Kigandain.Nairob. European Centre for Research Training and Development UK.
- [34] United Nations Development Programme (UNDP), (2010). Skills Gap Analysis for Graduates of Youth Polytechnics, Journal of Vocational Education Research. Vol.1(1),49-59.
- [35] Fluitman, F.,Birks, S. Oudin, X., & Sinclair, C. (1994). Skills acquisition in micro-enterprises: Evidence from West Africa. Paris: Organization for Economic Cooperation and Development.