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Assessing the use of On-Board Diagnostic Equipment by Ghanaian Informal Automobile Mechanics. A Case Study of Suame Magazine

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Abstract **-** *Automobile vehicles that are operated with electronic components require sophisticated equipment and well-trained personnel who can effectively handle and use this equipment to diagnose, repair, and maintenance of these categories of vehicles in the sub-Sahara part of the world. Informal automobile mechanics in Ghana are usually confronted with a lot of challenges when it comes to their chosen field of occupation.*

This article assesses the level of knowledge possessed by automobile mechanics within the informal sector in Ghana in the use of on-board diagnostic equipment.

Suame Magazine has been selected for this study because it is considered an industrial hub in the service and repair of automobile vehicles in Ghana.

The outcome of the study shows that one hundred and twenty-six (126), representing 30% of the total sample size are knowledgeable and skillful in the usage of this diagnostic equipment. Thirty-seven (37) representing 29.4% acquired such knowledge and skills through formal education.

The results further established that, though the mechanics in Suame Magazine possess multi-skills in diagnosing and repairing mechanical operated vehicles, their level of skills and knowledge in using On-Board Diagnostic equipment is not encouraging.

Keywords: *Automobile Mechanic, Electronic Cars, Informal, On-Board Diagnostic, Repair, and Maintenance*

1. INTRODUCTION

Improvement in fuel efficiency and engine operating efficiency has necessitated the introduction of more complex and microprocessors related components in the design of electronically controlled vehicle components which has brought about maximum engine output and safety to its occupants.

This significant advancement has brought more changes and exciting features into the general set up of the automobile vehicle; ensuring comfortability to its occupants, increase in engine output efficiency with a relative reduction in fuel consumption compared to conventional vehicles. [1]

In a journal article in [2] mechanics and technicians in the informal automotive industry in the Sub Sahara region have developed a negative attitudinal behavior since the introduction of electronic components in automobile vehicles due to its sophisticated nature and mode of operation. This has resulted in difficulties in the mode of diagnosing, repairing, and servicing these vehicles in most parts of Africa of which Ghana is no exception.

Automobile vehicles that are electronically controlled have in-built features consisting of electronic management system units (EMS) which involve on-board self – test capabilities that regularly examines and signal any malfunction within which the engine further communicates this development to the electronic control unit (ECU) [3]. The ECU further process the information to correct any malfunction within the engine configuration to achieve the desired output function and performance at any given point [4], [5], [6].

Reference [7] has established that due to the complex nature of these electronically operated vehicles, mechanics and technicians who are well-trained and skillful in the use of specially designed tools and equipment, such as the On-Board Diagnostics (OBD) equipment, can effectively use them to diagnose any malfunction that might arise and subsequently repair such fault with little difficulty.

It is against this background that well-trained skilled and specialized mechanics and technicians in this field of automobile electronics are required, who will be able to effectively handle this task very accurately and easily.

Currently, most informal automobile garage operators in Ghana are faced with numerous challenges which include lack of modern logistics such as OBD equipment, as well as skilled mechanics and technicians in the field of automobile electronics repair and maintenance as indicated by [8], [9]. The major challenges facing the roadside mechanics in Ghana as far as the advent of electronic vehicle technology is a concern is the lack of skills in the use of OBD scan tools

Fig, 1: A typical informal garage in Suame Magazine

[10]

Several studies have been carried out to ascertain the level of skills and mode of operation within the informal garage operators in Ghana. According to [8] a large number of the auto-mechanics in the informal garages in the country have considerable years of auto repair working experience but cannot inspect and repair modern automobile vehicles due to a low level of educational and technical know-how. The auto mechanics cannot also identify and use modern diagnostic equipment, manufacturers' manuals, computers, and the internet which have characterized modern vehicle repairs, in their repair practices. They also lack adequate tools, equipment, and other logistical supports. Similar results were also arrived at by [9].

Similar studies have also been performed by [2] and [11] to assess the performance of the informal automobile garage apprentice concerning the use of diagnostic tools in the repair and maintenance of electronic vehicles in some African countries. Reference [12] noted that motor vehicle mechanics trainers in Nigeria need capacity building on the use of auto scan tools for vehicle system diagnostics and repairs

The introduction of advanced technology into the modern vehicle is affecting the business of informal automobile repair garages negatively and gradually sending informal automobile mechanics out of business and that the main factor that contributes to the lack of knowledge on advanced automobile technology is low education. [13], [14]

Automobile garages in Ghana currently are categorized into five main groups:

- After Sales Service Branded New Cars Garages
- Informal Garages
- Specialist Branded Garages
- Service Station Garages
- Fleet Service Garages

After-sales service brand new garage operators in Ghana are formal garage operators whose mode of operation is well-planned and are representatives of a brand of vehicles in the country offering after-sales service to customers who own such particular brand-new vehicles.

Automobile garages operators of this brand of vehicles are characterized by well-trained mechanics and technicians who have acquired the requisite knowledge and are well-trained in the usage of these onboard diagnostic equipment and tools and other related sophisticated modern equipment to repair service, and maintaining these vehicles, but it is intriguing to realize these specialist garages do not have the required number of these skillful mechanics to effectively manage and carry out these services to customers when the need arises [15]. For this reason, most vehicle owners tend to patronize the services of these informal automobile garage operators who also do not have the necessary manpower in terms of skills in the

usage of these sophisticated diagnostic tools, thereby posing a lot of challenges to their operations and activities.

II. METHODOLOGY

The research work was performed within twelve months in Suame Magazine which is one of the industrial hubs for repair and service activities for automobile vehicles which is located in the Ashanti Region of Ghana.

In this research, a set of four hundred and twenty (420) structured questionnaires, as well as direct interviews approach, was adopted in assessing the level of skills and knowledge of the targeted respondents. Questionnaires in some cases were explained and administered in the local language, peers and master craftsman were also consulted in the rating of the respondent to arrive at fair and accurate results in the field of diagnosing, repairing, and servicing electronic-controlled vehicles.

Data collected primarily focused on the level of knowledge acquisition of mechanics, their working experience, and their expertise in the usage of diagnostic tools as well as their mode of acquisition of knowledge concerning on the job training, formal education, seminars as well as workshops attended.

III. RESULTS PRESENTATION AND DISCUSSIONS

Results, relating to the working experience of mechanics in the field of repairing and servicing electronic vehicles are presented in fig. 3. One hundred and twenty-six, of this, representing 30% are skillful mechanics in the usage of OBD equipment. Two hundred and ninety-four representing 70% is deemed not to be skillful when it comes to the handling and usage of these diagnostic tools.

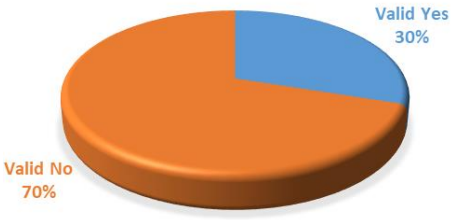

Fig. 2. Percentage of Valid Skilled Workers

Further discussion of this work showed that one hundred and twenty-six (126) mechanics who had the knowledge and are skillful in handling OBD tools and how such knowledge was acquired are shown in table 2.

Table 1: Number of years working as a mechanic

	Frequency	Percent
0-10	75	17.9
11-20	105	25.0
21-30	135	32.1
30 and above	105	25.0
Total	420	100.0

The results in table 1, established that seventy-five of the mechanics corresponding to 17.9% have been working in this field for the past ten years since the research began in June 2019, whilst one hundred and thirty-five, representing 32.1% of total skilled mechanics had acquired their working experience between the years of twenty-one and thirty, indicating the majority number of mechanics who possess a lot of working skills and experience acquired it through this period.

Table 2 illustrates the acquisition of knowledge concerning the usage of diagnostic tools. Analysis of the research indicates that thirty-seven (37) respondents representing 29.4% whiles sixty-five (65) representing 51.6% acquired their skills through formal education and on the job training respectively, whilst 24% acquired their skills through attending workshops, seminars as well as participating in in-service training during the period under review.

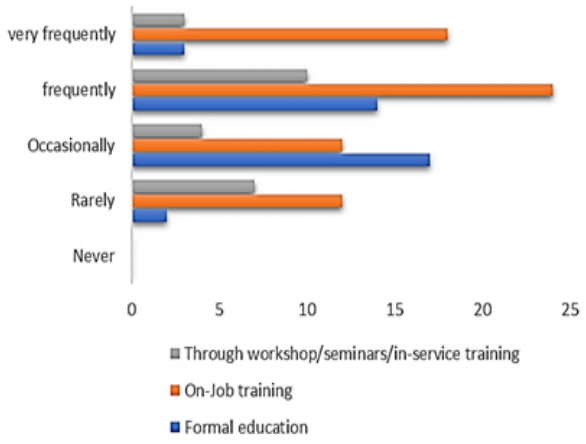

Figure 3 level of proficiency

Table2: How OBD skill was acquired

.	Working experience				**Total**
	0-10	11-20	21- 30	30 and above	
Formal education	36	1	0	0	**37**
On-Job training	20	26	13	6	**65**
Workshop/seminars /in-service training	4	6	8	6	**24**
Total	**60**	**33**	**21**	**12**	**126**

The proficiency of the respondent was assessed and the result is presented in table 3. The proficiency was based on the frequency of usage of scan tools using a scale of 1, 2,3,4, and 5 representing never, rarely, occasionally, frequently, and very frequently respectively. As seen in figure 4, the respondent who acquired the knowledge through on-the-job training uses the scan tools very frequently than the respondent who acquired it through formal education. From the data gathered as shown in table 3, 24 out of 126 respondents who use scan tools for diagnosing electronic vehicles, representing 19% can be considered as very proficient based on the frequency of usage. Considering the total number of respondents, it represents 5.7% as being proficient in the use of OBD tools.

Table 3: Proficiency of respondents

	1	**2**	**3**	**4**	**5**	**Total**
Formal education	0	2	17	14	3	**36**
On-Job training	0	12	12	24	18	**66**
workshop/seminars/in-service training	0	7	4	10	3	**24**
Total	**0**	**21**	**33**	**48**	**24**	**126**

The correlation analysis performed on the data collected is presented in table 4. The table generally shows a positive correlation which affirms that mechanics in the informal automobile garage possess multiple skills in the repair and maintenance of the vehicle. However, it is seen from the correlation analysis table, that correlation among diagnosing mechanically operated components shows higher correlation values than the correlation values between the electronically operated component and mechanical component.

As an example, the correlation between performing engine

tune-up and timing engine injection pumps accurately which are performed mechanically shows a positive correlation value of 0.603. However, the correlation between performing engine tune-up and usage of scan and diagnostic tools and equipment to diagnose, repair and maintain electronic components in automobile vehicles showed a much lower correlation value of 0.07. In the same way correlation values between using scan tools to repair and maintain the electronic vehicle and all the other activities involving mechanical component shows low correlation values.

This correlation result establishes that, though the mechanics in Suame magazine possess multi-skills in the field of diagnosing and repairing mechanical operated vehicles, they lack adequate skills and knowledge when it comes to the handling and usage of on-board diagnostic tools in diagnosing, repairing, and maintaining electronically controlled vehicles as indicated in the correlation analysis table.

IV. CONCLUSION

The outcome of this research shows that a low number of informal automobile mechanics in Suame Magazine do not use On-Board Diagnostic tools in diagnosing repairing and servicing electronic associated faults in automobile vehicles. Of this number, the majority of these machines using the scan tools acquired their skills through on-the-job training.

This shows that the skills level of the informal mechanics can be elevated not only through formal education but also on-the-job training. These results also reveal the weaknesses in the formal education system in training the needed man-power as far as repair and maintenance of modern automobile vehicles are concerned. For this reason, the quest by the government to pursue an apprenticeship program to address the youth unemployment situation and bridge the technological gap among its workforce is very commendable.

However, if the majority of mechanics acquires advanced technological know-how through such as using scan tools to diagnose and repair electronic vehicles through on-the-job training as against formal education, then the majority of these mechanics may lack the basic understanding in this trade area of which is considered more sophisticated and complex due to the design and constructional features of the components. This may also result in the lack of adequate knowledge of entrepreneurial and managerial skills of the informal mechanics to operate their informal automobile garage businesses in the fast-changing technological advancement in the automotive industry.

Suame Magazine is considered as one of the major hubs of automobile activities in Ghana with diverse skills and artistry knowledge which needs to be given attention so that the potential skills of these mechanics can be fully developed and utilized. This could be done by cultivating the interest in basic electronics theories and understanding of these mechanics concerning the usage and handling of the diagnostics tools through formal educational training.

Government and stakeholders should invest in this area by equipping educational training institutions throughout the country as well as equipping these existing informal garages through its unionized garage associations across the country

Frequent workshops and training sessions for these informal garage mechanics should be made a priority by the government as part of its comprehensive industrial transformational agenda as contained in its coordinated program of economic and social development policies (CPESDP). All stakeholders in the country should coordinate very effectively to fully utilize the potentials of these mechanics in this ever-growing sophisticated industry.

Table 4. Correlation Analysis

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Performing engine tune-up accurately	1	1	.603	.560	.227	.540	.352	.466	.403	.455	.375	.238	.170	.255	.159	.520	.371	.070	.284	.208	.456
Timing engine injection pumps accurately	2	.603	1	.606	.344	.657	.561	.601	.490	.467	.357	.288	.196	.148	.250	.649	.521	.183	.132	.245	.231
Timing of an engine valves	3	.560	.606	1	.224	.497	.397	.501	.678	.277	.491	.443	.083	.189	.150	.498	.447	.168	.333	.313	.402
Calibration of the fuel injection pump accurately	4	.227	.344	.224	1	.463	.356	.301	.332	.383	.362	.415	.530	.387	.115	.367	.426	.176	.327	.339	.321
Performing ignition timing accurately	5	.540	.657	.497	.463	1	.683	.579	.530	.585	.338	.453	.435	.357	.195	.560	.477	.081	.323	.366	.479
Fixing of single-point fuel injection systems	6	.352	.561	.397	.356	.683	1	.710	.333	.493	.121	.276	.370	.444	.386	.428	.485	.186	.080	.298	.332
Fixing of multi-point fuel injection systems	7	.466	.601	.501	.301	.579	.710	1	.395	.473	.290	.308	.323	.417	.353	.545	.494	.231	.223	.375	.435
Overhauling an engine	8	.403	.490	.678	.332	.530	.333	.395	1	.331	.457	.538	.269	.132	.103	.401	.359	.168	.312	.263	.402
Performing phase angle test accurately	9	.455	.467	.277	.383	.585	.493	.473	.331	1	.285	.228	.363	.244	.370	.475	.393	.190	.026	.251	.230
Working on lubrication systems	10	.375	.357	.491	.362	.338	.121	.290	.457	.285	1	.353	.096	.011	.073	.491	.382	.044	.294	.253	.263
Repairing air braking systems	11	.238	.288	.443	.415	.453	.276	.308	.538	.228	.353	1	.224	.122	.133	.368	.245	.141	.217	.215	.396
Repairing a servo-assisted hydraulic system	12	.170	.196	.083	.530	.435	.370	.323	.269	.363	.096	.224	1	.379	.151	.187	.185	.192	.319	.394	.344
Repairing alternator systems	13	.255	.148	.189	.387	.357	.444	.417	.132	.244	.011	.122	.379	1	.303	.233	.293	.090	.337	.276	.281
Installation and diagnosis of sensor and actuators related maintenance	14	.159	.250	.150	.115	.195	.386	.353	.103	.370	.073	.133	.151	.303	1	.345	.256	.479	.014	.247	.030
Repairing manual transmission systems	15	.520	.649	.498	.367	.560	.428	.545	.401	.475	.491	.368	.187	.233	.345	1	.531	.127	.168	.280	.225
Repairs of automatic transmission systems	16	.371	.521	.447	.426	.477	.485	.494	.359	.393	.382	.245	.185	.293	.256	.531	1	.185	.133	.258	.176
Using scan tools to repair and maintain electronic vehicles	17	.070	.183	.168	.176	.081	.186	.231	.168	.190	.044	.141	.192	.090	.479	.127	.185	1	.143	.292	.086
Fixing problems on water cooling systems	18	.284	.132	.333	.327	.323	.080	.223	.312	.026	.294	.217	.319	.337	.014	.168	.133	.143	1	.439	.539
Fixing problems on air cooling systems	19	.208	.245	.313	.339	.366	.298	.375	.263	.251	.253	.215	.394	.276	.247	.280	.258	.292	.439	1	.534
Repairing vehicle suspension systems accurately	20	.456	.231	.402	.321	.479	.332	.435	.402	.230	.263	.396	.344	.281	.030	.225	.176	.086	.539	.534	1

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