RELEVANCE OF ON-BOARD DIAGNOSTIC MACHINE FOR IMPROVED JOB PERFORMANCE OF AUTOMOBILE CRAFTSMEN IN THE INFORMAL SECTOR OF ORUMBA SOUTH L.G.A OF ANAMBRA STATE

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Abstract
The study was designed to determine the relevance of the use of On-Board diagnostic (OBD) machine to the craftsmen in informal automobile workshops in trouble shooting/servicing of vehicles in Orumba South L.G.A. of Anambra State. Three research questions in line with the purpose of the study were formulated while three null hypotheses were tested at 0.05 level of significance. The study adopted a survey research design. The population for the study was 96, comprising 10 auto-electrical craftsmen and 86 auto-mechanical craftsmen. A 29 item questionnaire was designed to collect data for the study. The instrument was validated by three experts. Cronbach Alpha Reliability coefficient was used to determine the internal consistency of the instrument. The instrument yielded a reliability coefficient of 0.88 indicating that the instrument was highly reliable. The data collected from the research question which guided the study were answered using mean with standard deviation, whereas hypotheses were tested with t-test. The result of the study showed that; OBD machines were relevant in informal automobile maintenance workshops; the craftsmen had constraints in the use of OBD machine in servicing motor vehicles. Training and retraining programmes could be used to address the constraints of these craftsmen. It was recommended that government and non-governmental organizations should help to extend the technological innovations enlightenment campaign and education to craftsmen in the informal workshop in Orumba South LGA of Anambra State.

Key words: *On-board diagnostic machine, workshop, automobile, craftsmen, trouble shooting.*

Introduction
The automotive industry in the world is making effort to reduce the mechanical linkages and increase the communication network of the vehicle brain box. This technology is seen to be mechatronics in nature. Mechatronics is the study of multi-disciplinary integration of mechanical, electronics and computer system (Vanston, Elliot, Brazll, Evans, Irwin and Betterworth, 2007). This mechatronics technology in automobile vehicle enables the vehicle to be diagnosed with ease. Automobile system consists of mechanical, hydraulic, software and hardware components. Software intensive electronic control systems are increasingly being used in the automobile industry to provide convenience and safety features to vehicle drivers and passengers with increasing levels of automation and

control authority (Larrigan, Kavulya, Narasimhan, Furhrman and Salman, 2011). A growing trend is to assist the driver in maintaining safe control over the motion of the vehicle under a variety of conditions. However, as automobile vehicle become more "electronic", especially the addition of computerized On-Board Diagnostic (OBD) tools in the 1980's, automobile technicians and craftsmen have to become familiar with the electronic control system that monitor and control the vehicle operation.

On-Board Diagnostic machine is designed to identify problems and provide a guide for determining where faults might be within a vehicle. According to Hermann (2006), on-board diagnostic machine is an electronic device designed to assist technicians for easy fault detection and avoid trial and error method of fault detection. On-Board Diagnostic (OBD) is an automobile term referring to a vehicle self diagnostic and reporting capability (Wikipedia, 2015). OBD systems give the vehicle owner and repair technicians and craftsmen access to the status of the vehicle sub-system. The amount of information available via OBD has varied widely since its introduction in the early 1980's. Early version of OBD would simply illuminate a malfunction indicator light or "idiot light" that a problem was detected but would not provide any information as to the nature of the problem. Modern OBD implementation use a standardized digital communication port to provide real time data in addition to a standardized series of diagnostic trouble codes (DTCs) which allow one to rapidly identify and remedy malfunctions within the vehicle.

On-Board Diagnostic (OBD) machine had been improved and were classified into two major generations. The first generation of OBD machine (OBD-I) was developed by the California Air Resource Board (CARB) and implemented in 1988 to monitor some of the emission control components on vehicle. The regulatory intent of OBD-I encouraged auto manufacturers to design reliable emission control system that remain effective for vehicle "useful life". The diagnostic trouble codes (DTCs) of OBD-I vehicle could be accessed without an expensive "scan tool". Each automobile manufacturer uses his own diagnostic link connector (DLC), DLC location, DTC definition and procedure to read the DTCs from the vehicle. DTCs from OBD-I cars are often read by the blinking pattern of the "Check Engine Light" (CEL) or service engine soon (SPS) light. The DTCs of some OBD-I cars are interpreted in different ways. As technology evolved and the desire to improve the OBD system increased, a new generation of OBD machine was designed as "OBD-II"

The OBD-II system is designed to monitor emission control systems and key engine components by performing either continuous or periodic test of specific components and vehicle conditions. When a problem is detected, the OBD-II system turns on as warning lamp (that is, malfunction indicator light MIL) on the vehicle instrument panel to alert the driver typically by the phrase of "check engine" or "service engine soon". The system also stores important information about the detected malfunction so that a technician or craftsmen can accurately find and fix the problem (Algirdas, Laprie, Brain and Carl, 2004).

OBD-II is an improvement over OBD-I in capacity and standardization. The OBD-II standard specifies the type of diagnostic connector and pin out, the electrical signaling protocols available and the messaging format. It also

provides a candidate list of vehicle parameters to monitor along with how to encode the data for each. There is a pin in the connector that provides power from the scan tool to a power source separately. According to Rolf (2005) in Lanigan, Kavulya, Narasimhan, Furhrman and Salman (2011), some technicians and craftsmen are still connecting the scan tool to an auxiliary power source to protect data in the unusual event when a vehicle experiences a loss of electrical power due to a malfunction. OBD-II standardization was promoted by emission requirement, though only emission related codes and data are required to be transmitted through it. Most manufacturers have made the OBD-II data link connector, the only one in the vehicle through which all systems are diagnosed and programmed. The On-Board Diagnostic control systems are instrumental to the production of diagnostic trouble codes (DTCs) that indicate errors and identify the faulty system, component or circuit. The old method of trial and error used in most conventional vehicle leads to wasteful replacement of functional components, therefore causing high rate of No Fault Found (NFF). The new method of trouble shooting fault with codes programmed to individual parts with the electronic control unit (ECU) is economical and reliable in vehicle maintenance.

On-Board Diagnostic trouble codes are electronic programmed code used to store and read the various components of the vehicle (Hermann 2006). In OBD-II system, diagnostic trouble codes are codes that are stored by on-board computer diagnostic system in response to a problem found in the vehicle. These codes identify a particular problem area and are intended to provide the user with a guide as to where a fault might be occurring within a vehicle system. OBD-II diagnostic trouble codes consist of a five digit alphanumeric code. The first character, a letter identifies which control system that generates the code. The letter codes are as follows:

P- for engine and transmission (power train),B- for body,C- for chassis and U- for network. Then the other four characters, all numbers, provide additional information on where the DTC originated and the operating condition that caused it to set.

Modern automobile products are complex, semi-autonomous mechatronic system that rely on sophisticated in-car monitor and control system for their operation (Algirdas el-tel, 2004). These systems include electronic fuel injection, anti-lock braking, cruise control, telematics (on star) and tyre pressure monitors. Increasingly, automobile manufacturers are investigating drive by wire, brake by wire and throttle by wire technology as a mean of replacing mechanical connections such as push rods, overhead cam, cables, steering columns, hydraulic master cylinder and pipes. The plan according to Vanston, Ellioth, Brazell, Eliza, Irwin and Betterwaorth (2007) is to remove the mechanical connections in a car and devices that actually do the work. These mechatronics based system provide faster response to critical condition which trial and error method or even experience cannot provide. Automobile technicians and craftsmen who service hybrid vehicles of this nature have to not only completely learn new skills related to the car's complex computer controlled energy management system and electronic motors/generators but also have to learn how to safely maintain the car (Larsen, 2002). Servicing of a vehicle especially modern once demands the

determination of the cause of the problem through trouble shooting. Trouble shooting is the act of identifying and resolving the root cause of the problem in a machine or device. Therefore, servicing of hybrid vehicle requires proper trouble shooting of the vehicle to identify the actual fault before repair. Safety of the vehicle and that of the personnel conducting the trouble shooting is necessary.

Safety precautions are required in the use of On-Board Diagnostic machine in automobile maintenance workshops to prevent personal injury or damage to vehicle and/or the machine (Scan tool) include the following safety precaution;

1. Always perform automobile testing in a safe environment.
2. Wear safety eye protection.
3. Keep clothing, hair, hands, tools and test equipment away from all moving or hot engine parts.
4. During trouble shooting, operate the vehicle in a well ventilated work area; exhaust gases are poisonous.
5. Put blocks in front of the vehicle wheels and never leave the vehicle unattended while running a test.
6. Use extreme caution when working around the ignition coil, distributor cap, ignition wires and spark plugs. These components create hazardous voltage when the engine is running.
7. Put the transmission in PARK (for automatic) or NEUTRAL (for Manual) and make sure the parking brake is engaged.
8. Keep a fire extinguisher suitable for gasoline, chemical and electrical fire near by
9. Do not connect or disconnect any test equipment while the ignition is on or the engine is running.
10. Keep the scan tool dry, free from oil and water or grease. Use a mild detergent and a clean cloth to clean the outside of the scan tool when necessary.

The importance of OBD Machine in Automobile Workshop for the maintenance of millennium vehicles cannot be over emphasized. According to Robert and Philip (2003) the relevance of OBD machines in trouble shooting include;

1. high fault detection coverage.
2. rapid recovery from failures, or short failure detection.
3. short time to repair periods.
4. greater reliability and cost effectiveness.
5. simplifying of mechanical design problem during trouble shooting.
6. it has the ability to adapt and optimize product functionality during operation and repair work. Indeed, OBD machine plays some indispensable role in the new technological development in automobile maintenance, trouble shooting and fault detection. It may be necessary to study the perceptive view of the populace especially the road-side automobile craftsmen about the use and relevance of the machine in trouble shooting.

However, the National Policy on Education (2013) defines craftsmen as those who have been trained in technical education at secondary school levels and who have acquired necessary knowledge and skills that would enable the individuals to be enterprising and self-reliant. A craftsman is a skilled personnel in automobile workshop with good knowledge of the use of tools and components of the vehicle. The craftsmen who successfully complete their training programme through formal education may find jobs in industries or employ themselves by establishing their own businesses. Some of these

mechanics in the informal sectors are trained through a rigorous apprenticeship programme provided by their masters.

In Nigeria, formal and informal automobile workshops exist. According to Alio and Uzor (2010), the formal sector consists of the large organized private and public enterprises. The informal means not formal, without formality and proper organization. For instance, the ‘‘road side” mechanics craftsman does not require any kind of registration or formal education in order to open up his workshop. The informal sector forms a link with the formal and consequently provides employment and economic empowerment to the people. Upon this background, the need arises to determine how the craftsmen in the informal automobile maintenance workshops perceive the relevance of OBD machine for improving their performance.

The automobile industry is moving in to the future where automation, actuators and sensors will be used in most vehicle components and systems. The sensors integrated in the vehicle design make it possible to assess the vehicle with sophisticated electronic machine hence, deletes the era of trial and error (Vaston, 2007). The researcher wonders if the craftsmen in the informal automobile workshops are aware of the relevance of this modern technology in trouble shooting. It is not proper to watch the situation where the craftsmen would be laid off because of the new technology which has become the order of the day. The trial and error method seem not to be useful in the new vehicles in recent time. When the trend is not checked, it will cause unemployment among technicians and craftsmen in automobile sector. Consequently, the problem of the study is; what is the relevance of on-board diagnostic machine in automobile workshop as perceived by craftsmen in informal sector in Orumba South L.G.A. of Anambra State.

The main purpose of the study was to determine the relevance of On-Board Diagnostic machine in automobile workshop as perceived by auto-mechanic technicians in the informal sector in Orumba South L.G.A. of Anambra State. Specifically, the study sought to determine;

1. the usefulness of on-board diagnostic machine in trouble shooting/servicing of vehicle in automobile workshops in Orumba South L.G.A. of Anambra State
2. the constraints to automobile craftsmen in the use of on-board diagnostic machine in trouble shooting/servicing of vehicles in automobile workshops in Orumba South L.G.A. of Anambra State.
3. the strategies for improving the use of on-board diagnostic machine in trouble shooting/servicing of vehicles in automobile workshops in Orumba South L.G.A. of Anambra State.

Research Questions

The following research questions were answered by the study.

1. What are the usefulness of on-board diagnostic machine in trouble shooting/servicing of vehicle in automobile workshops in Orumba South Local Government Area of Anambra State?
2. What are the constraints to automobile craftsmen in the use of on-board diagnostic machine in trouble shooting/servicing of vehicle in automobile workshops in Orumba South Local Government Area of Anambra State?

3. What are the strategies for improving the use of on-board diagnostic machine in trouble shooting/servicing of vehicles in automobile workshops in Orumba South Local Government Area of Anambra State?

Scope of the Study

Relevance of On-Board Diagnostic Machine for improved Job Performance of Automobile Craftsmen in the Informal Sector of Orumba South

Hypotheses

The following hypotheses were tested at 0.05 level of significant:

H_{o1}: There is no significant difference in the mean ratings of auto-electrical and auto-mechanical craftsmen with respect to usefulness of on-board diagnostic machine in trouble shooting/servicing of vehicle in automobile workshops in Orumba South L.G.A. of Anambra State.

H_{o2}: There is no significant difference in the mean ratings of auto-electrical and auto- mechanical craftsmen with respect the constraints to the use of on-board diagnostic machine in trouble shooting/servicing of vehicles in automobile workshops in Orumba South L.G.A. of Anambra State.

H_{o3}: There is no significant difference in the mean ratings of auto-electrical and auto-mechanical craftsmen with respect to the strategies for improving the use of on-board diagnostic machine in trouble shooting/servicing of vehicles in automobile workshops in Orumba South L.G.A. of Anambra State.

Method

A survey research design was adopted for the study. According to Alio (2008), a survey research design is one in which a group of people or items are studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group or by collecting and analyzing data from the entire people or items. The study adopted survey research design because the instrument was polychotomously scored.

The population of the study was 96 respondents made up of 10 auto-electrical craftsmen and 86 auto-mechanical craftsmen (under the umbrella of Nigerian Automotive Technologist and Technicians Association) in Orumba South L.G.A. No sampling was done due to the manageable size of the population.

A 29 item structured questionnaire developed by the researcher was used to collect data from the respondents. It consisted of two parts, Part I and II. Part-I was designed to elicit information on the bio-data of the respondents using such information as the educational qualification of the respondents. Part II was made up of three sections; section A, B and C which contained 12 items, seven items and 10 items respectively. The instrument was face validated by three experts, one expert from Department of Science and Computer Education (measurement and evaluation) and two experts from Department of Technology and Vocational Education (mechanical technology option) all in Faculty of Education of Enugu State University of Science and technology (ESUT), Enugu. The comments of the valuators' guided the modification of the final instrument. The reliability of the instrument was obtained using Cronbach Alpha and the coefficient of reliability computed from result of a pilot study conducted with 20 mechanic craftsmen in Enugu North Local Government Area of Enugu State yielded 0.88. All the items were responded to by the subject using a four point scale of Strongly Agree (SA) Agree

(A) Disagree (D) and Strongly Disagree (SD). The responses were weighted – 4, 3, 2 and 1 respectively. The instrument was administered and collected by the researcher personally. Out of 96 copies of the questionnaire 95 copies were properly completed, collected and used for data analyses, representing 98.95 percent return rate. Mean with standard deviation was used to answer the research questions. For decision to be reached, the mean of the scaling values was computed, thus (4 + 3 + 2 + 1)/4 = 2.50. In other words, mean of 2.50 and above was regarded as agree whereas any mean less than 2.50 was indicated as disagree by the respondents.

The null hypotheses were tested using t-test. Where the value of the obtained t-test was equal or greater than critical value at 0.05 level of significance, the null hypothesis was rejected, otherwise do not reject.

Results

The findings of the three research questions and the three hypotheses are presented in tables 1 to 6.

Research Question 1

What is the usefulness of on-board diagnostic machine in trouble shooting/servicing of vehicle in informal automobile workshop in Orumba South Local Government Area of Anambra State?

Table 1: Mean responses with standard deviations of respondents' responses on the usefulness of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop in Orumba South Local Government Area of Anambra State.

S/N	usefulness of OBD	Auto-Electrical craftsmen N= 10		Auto-Mechanical Craftsmen N=85		overall		Rmks
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	
1.	On-Board Diagnostic (OBD) machine helps in easy fault detection	3.20	1.03	3.57	0.72	3.39	0.88	Agree
2.	OBD machine x-rays all the vehicle component during trouble shooting	2.90	0.74	3.07	0.61	2.99	0.68	Agree
3.	OBD machine enables detection of faulty component that will cause vehicle failure	3.00	1.05	3.36	0.72	3.18	0.89	Agree
4.	It has greater reliability when trouble shooting is conducted	3.30	0.67	3.27	0.64	3.29	0.66	Agree
5.	OBD machines provide access to complex automobile design during fault diagnoses	3.00	0.94	3.12	0.81	3.06	0.87	Agree
6.	OBD machines provides solution to detected problem during trouble shooting	3.30	0.52	3.14	0.69	3.22	0.61	Agree
7.	OBD machine can adapt to different Vehicles	2.90	0.87	2.92	0.67	2.91	0.77	Agree
8.	It enables fast repair work	3.00	1.05	3.28	0.89	3.14	0.97	Agree
9.	Complex automobile faults are simplified with the use of OBD machines when the engine is not on.	3.20	0.63	3.07	0.63	3.14	0.63	Agree

10	It can communicate with the vehicle when the engine is not on	2.90	0.74	3.05	0.76	2.98	0.75	Agree
11	It helps to know what to touch and what not to touch	3.60	0.52	3.45	0.61	3.53	0.57	Agree
12	It helps to interpret codes displayed on the vehicle dash board	2.90	0.38	3.35	0.96	3.13	0.67	Agree
	Cluster Mean ($\overline{X}$)	3.10	0.76	3.22	0.73	3.16	0.75	agree

Table 1 shows that all the items are agreed by the respondents. This simply means that OBD machine is useful in the servicing/trouble shooting of automobile vehicle in informal automobile workshop. The data also reveal that OBD machine is useful to auto-electrical craftsmen in trouble shooting/servicing of vehicle with grand mean scores of 3.10 and standard deviation of 0.76. Also auto-mechanic craftsmen agree that the OBD machine is useful with grand mean scores of 3.22 and standard deviation of 0.73. This is further authenticated by the overall grand mean of 3.16 and low grand standard deviation of 0.76 showing the closeness of their responses.

Hypothesis 1:

There is no significant difference in the mean responses of Auto- electrical and auto mechanical on the relevance of OBD machine in informal automobile workshop in Orumba South L.G.A. of Anambra State.

Table 2: t-test result on the relevance of OBD machine in informal automobile workshops in Orumba South L.G.A. of Anambra State.

Variables	**N**	**$\overline{X}$**	**SD**	**df**	**t.cal**	**p**	**t-cri**	**Decision**
Auto- Mechanical	85	3.22	0.73	93	0.49	0.05	1.98	Do not
Auto-Electrical	10	3.10	0.76					reject

Table 2 shows the t-calculated value of 0.49 which is less than the t-critical value of 1.98. This reveals that there is no significant difference in the opinion of auto mechanical and auto-electrical craftsmen on the usefulness of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop. Therefore the null hypothesis is not rejected.

Research Question 2:

What are the constraints of craftsmen in the use of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop in Orumba South L.G.A of Anambra State?

Table 3: Mean responses with standard deviation of respondents' response on the constraints in the use of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop in Orumba South L.G.A. of Anambra State.

S/N	usefulness of OBD	Auto-Electrical craftsmen N= 10		Auto-Mechanical Craftsmen N=85		overall		Rmks
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	
1.	On-board diagnostic (OBD) machines are difficult to switch on during fault switch on during fault diagnosis	3.00	0.94	2.78	0.96	2.89	0.95	Agree
2	The codes are hard to interpret during trouble shooting	3.30	0.67	2.94	0.89	3.12	0.78	Agree
3	Some of the vehicle are not OBD compliant	3.10	0.88	3.22	0.78	3.16	0.83	Agree
4.	Some vehicle owners don't like the use of the machine in trouble shooting their vehicle	2.80	0.92	2.49	0.97	2.65	0.95	Agree
5.	The workshop environment does not permit the use of On-Board Diagnostic machine	2.90	0.99	2.82	0.87	2.86	0.93	Agree
6	Learning the diagnostic trouble codes DTCs is not easy	3.00	1.05	2.95	0.96	2.98	1.01	Agree
7	Some vehicles have difference connector plug for the machine	3.30	0.92	3.24	0.67	3.27	0.79	Agree
	Cluster Mean ($\overline{X}$)	3.06	0.91	2.92	0.87	2.99	0.89	agree

Table 3 reveals that craftsmen in informal automobile workshop have constraints in the use of OBD machine in trouble shooting/servicing of vehicle. Auto-mechanical craftsmen disagree with item number 4 with a mean score of 2.49 which seeks their opinion on the behaviour of vehicle owner in the use of OBD machine in trouble shooting/servicing their vehicles. In the other six items, the respondents agree that they are the constraints in the use of OBD machine in informal automobile workshop.

Hypothesis 2:

There is no significant difference between the mean score of auto mechanic and auto electrical craftsmen on the constraints in the use of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop in Orumba South L.G.A of Anambra State.

Table 4: t-test result on the constraints in the use of OBD machine in informal automobile workshop in Orumba South L.G.A. of Anambra State.

Variables	N	$\overline{X}$	SD	df	t-cal	P	t-crit	Decision
Auto- mechanical	85	2.92	0.87	93	0.46	0.05	1.98	Do not
Auto-electrical	10	3.06	0.91					reject

Table 4 shows a t-calculated value of 0.46 which is less than the t-critical value of 1.98. Hence, there is no significant difference in the opinion of respondents on the constraints in the use of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop. The null hypothesis is therefore not rejected.

Research Question 3

What are the strategies for addressing the constraints of auto-mechanic/electrical craftsmen in the use of OBD machine in trouble shooting/servicing of vehicle in informal automobile workshop in Orumba South L.G.A. of Anambra State.?

Table 5: Mean responses with standard deviation of respondents' response on the strategies for addressing the constraints in the use of OBD machine in trouble shooting and servicing of vehicle in informal automobile workshop in Orumba South L.G.A. of Anambra State.

S/N	usefulness of OBD	Auto-Electrical craftsmen N= 10		Auto-Mechanical Craftsmen N=85		overall		Rmks
		$\overline{X}$	SD	X	SD	$\overline{X}$	SD	
1.	Organizing training programme for the craftsmen on the use of on board diagnostic machine in trouble shooting	3.40	0.69	3.54	0.75	3.47	0.72	Agree
2	Public enlightenment to educate the public on the new automobile trouble shooting technology	3.50	0.71	3.44	0.66	3.47	0.69	Agree
3	Organizing seminar/ Workshop on the use of OBD machine	3.10	0.74	3.15	0.73	3.13	0.74	Agree
4	Provision of connector plug adaptor for all vehicle with OBD device	3.40	0.52	3.19	0.72	3.29	0.62	Agree
5	Organizing seminar/ workshop for the craftsmen on the use of diagnostic trouble codes in the OBD machine or Vehicle	3.40	0.52	3.33	0.52	3.37	0.52	Agree
6	Organizing seminars for the craftsmen on the relevance of OBD machines in trouble shooting/servicing of automobile vehicles	3.50	0.51	3.65	0.57	3.58	0.64	Agree
7	Improvement in manufacturers-informal workshop relationship	3.30	0.67	3.31	0.67	3.31	0.67	Agree

8	Organizing seminars for the craftsmen on safety measure in the use of OBD machine	3.10	0.88	3.31	0.79	3.21	0.84	Agree
9	Provision of retraining programmes for the craftsmen on the current automobile technology innovations	3.60	0.52	3.38	0.67	3.49	0.60	Agree
10	Provision of retraining programmes for the craftsmen on skills to enable them cope with the innovation	3.40	0.69	3.33	0.73	3.37	0.71	Agree
	Cluster Mean ($\overline{X}$)	3.37	0.67	3.36	0.68	3.37	0.74	Agree

Data in table 5 shows that the mean responses of the respondents are above the cutoff point of 2.50. This is an indication that the auto-electrical/auto-mechanic craftsmen in informal automobile workshop in Orumba South L.G.A of Anambra State agree on the 10 strategies identified for addressing the challenges encountered in the use of OBD machine in trouble shooting and servicing of vehicle. The grand mean for all the items in the table is 3.37 and grand standard deviation is 0.74, which denote that the craftsmen have a consensus opinion.

Hypothesis 3

There is no significant difference between the mean responses of auto-electrical and auto-mechanical craftsmen on the strategies for addressing the constraints in the use of OBD machine in informal automobile workshop.

Table 6: t-test result on the strategies for addressing the constraints in the use of OBD machine in informal automobile workshop in Orumba South L.G.A. of Anambra State.

Variables	**N**	**$\overline{X}$**	**SD**	**df**	**t-cal**	**P**	**t-critical**	**Decision**
Auto- mechanical	85	3.36	0.68	93	0.05	0.05	1.98	Do not
Auto-electrical	10	3.37	0.67					reject

Table 6 presents a t-calculated value of 0.05 which is less than the t-critical value of 1.98. Therefore, there is no significant difference in the opinion of respondents on the strategies for addressing the constraint of these craftsmen in the use of OBD machine in informal automobile workshop. Hence, the null hypothesis is rejected.

Discussion of Results

The result in research question one revealed that OBD machine was useful in the trouble shooting and servicing of automobile vehicle in the informal automobile workshop in Orumba South L.G.A. The result showed that complex automobile vehicle designs were made simple during fault detection. This agreed with the findings of Philip (2003) that OBD machine facilitate easy fault detection and short time to repair periods. The result of the study also showed that OBD machine x-rays the entire vehicle component during trouble shooting with greater reliability, providing solution area to detected problem with relevant codes. The test of hypothesis one showed that a

null hypothesis was not rejected. That indicated that there was no significant difference on the mean responses of auto-electrical and auto-mechanic craftsmen on the usefulness of OBD machine in informal automobile workshop.

Further, the result of research question two showed that the craftsmen in the informal automobile workshop had constraints in the use of the machine. The study showed that OBD machine codes and connector plug complied with non OBD compliant vehicles and hindered them for using the machine. Herman (2006) noted that OBD trouble codes are electronic programmed codes used to store and interpret the various components of the vehicle. Data from the null hypothesis two test also showed that there was no significance difference on the mean responses of auto-electrical and auto-mechanics craftsmen on the constraints in the use of OBD machine informal automobile workshop.

The result of research question three also identified the constraints in the use of OBD machine in informal automobile workshop by craftsmen in Orumba South L.G.A. The study found that organizing training programme, seminar, workshop and public enlightenment aimed at developing the technical competencies of the craftsmen would address the constraints. The finding was in line with Alio (2010), which reported that provision of extension education was a commendable strategy for developing skills of craftsmen. The result of null hypotheses three indicated that it should not be rejected. That indicated that there was no significance difference between the mean responses of auto-electrical and auto-mechanic craftsmen on the strategies for improving the use of OBD machine informal automobile workshop.

Conclusion

Craftsmen in informal automobile workshop are practically skilled human resource that can use tools and equipment do trouble shoot and maintain automobile vehicles. The importance and contributions of automobile craftsmen to the economic growth and development of Nigeria is quite remarkable. These craftsmen in informal automobile workshop are finding it difficult to migrate to the new technology used in trouble shooting and servicing of 21st century vehicle. All the 21st century vehicles are OBD compliance and only the machine could be used in its maintenance. The result of the study revealed that the craftsmen should be trained on the modern technology before they would be scraped out of the modern system.

Recommendations

The following recommendations were made:

1. Training and re-training programme should be organized to develop modern trouble shooting and servicing skill among the craftsmen.
2. Non-governmental organization interested in entrepreneurial and human resource skill development in the informal sector should raise up to the challenge of technological inventions and extend enlightenment to craftsmen in their workshop.
3. Vehicle manufacturers should be unified connector plugs design to enable the craftsmen to trouble shoot effectively.

References

Algirdas, A., Jean-chaude, L., Brain, R. and Carl, L. (2004). *Basic concepts and taxonomy of dependable and secure computing.* Institute of Electrical and Electronics Engineers Transactions on Dependable and secure computing, 1(1):11-33.

Alio, A.N. (2008). *Fundamentals of Education research.* Enugu samireen Nig. Ltd.

Alio, A.N. and Uzor, O.O. (2010). Enhancing management competencies of elctronices craftsmen in the informal sector of the economy of Enugu State Nigeria; *International Technology research journal (INTERJ).* 1(1) 38-51.

Federal Republic of Nigeria,(2013). *The national policy on Education.* Lagos, NERDC press.

Hermann, K. (2006). On the fault hypothesis for a safety-critical real-time system. Automotive software-connected services in mobile Networks, 4147:31-42. Lecture Notes in computer science. *Retrieve from 29/07/2015 http://www.goggle/ Automotive software,*

Hornby, S.A. (2006). *Oxford Advanced Learner's dictionary of current English.* Oxford; Oxford University press.

Larrigan, P.E., Kavulya, S., Narasimhan, N., Fuhrman, T.E., and Salam, A.M. (2011). Diagnosis in Automobile systems: A survey parallel Data laboratory, Carnegie mellon University. *Retrieved from on 29/07/2015 http://www.googlesearch/on-board diagnostic machine.*

Larsen, R. (2002). Hybrid technology and collision repair. Automobile service Association. Retrieved on 23/07/2015 fromhttp://www.asashop.org/autonic/apri/2002/collisoi n.cf.

Robert, C. H. and Philip S.B. (2003). *Achieving one Billion dependability with drive by wire system. SAE Technical paper series, SAE International;* warrendale, PA USA. 2003- 01-1290.

Spong, M. (2004). Future careers in embedded systems, mechatronics, and control. *Retrieved on 23/07/2015 from www.mathsku.edu/ksacg/css/CDCO33*.

Vaston, J.H; Elliott, H. Brazell I, Evans, E. Irwin J.A and Bettersworth, M.A. (2007). *Mechatronic: A Technology forecast.* TSTC publishing; Waco.

Wikipedia, (2015). Wikipedia the free encyclopedia. Retrieved on 25/07/2015 from http://en.wikipedia.org/wiki/on board diagnostic.