Emerging Maintenance Competencies Needs for Improved Automobile Enterprises by Motor Vehicle Mechanics in Yenagoa, Bayelsa State, Nigeria

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ABSTRACT

This study aimed to determine the Emerging Maintenance Competencies Needed for Improve Automobile Enterprises by Motor Vehicle Mechanics in Yenagoa, Bayelsa State, Nigeria. The study was guided with two purposes, two research questions, and two null hypotheses. A descriptive research design was adopted. The population of the study includes 140 master craftsmen (motor vehicle mechanics) and 14 automobile industrial technicians were used for the study, making a total population of 154 respondents. A simple random sampling technique was used. Data were collected using a structured questionnaire titled Automobile Enterprises Emerging Maintenance Competencies Questionnaire (AEEMCQ). The instrument was adapted by the researcher and validated by three experts. The reliability coefficient of the instrument were 0.86 and 0.84 with reliability index of 0.85, established using Cronbach's Alpha reliability test. Data analysis was conducted using SPSS Version 23, while mean and standard deviation were used to answer the research questions and t-test statistics was used to test the null hypotheses at 0.05 significance level. Findings revealed among others that all identified emerging maintenance competencies related to the fuel system were rated as highly needed with a grand mean of 3.52. Similarly, all emerging maintenance competencies related to the transmission system were also rated as highly needed by motor vehicle mechanics for establishing automobile enterprises in Yenagoa, Bayelsa State with a grand mean of 3.52. Based on the findings of the study, it was recommended that National Automotive Design and Development Council (NADDC), in collaboration with the Federal Ministry of Labour and Productivity, integrate these competencies into training programs for motor mechanics.

Keywords: Motor Vehicle Mechanic, Emerging Maintenance Competencies, Maintenance and Automobile Enterprise.

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INTRODUCTION

Motor vehicle mechanics, a branch of mechanical engineering, involves acquiring scientific knowledge related to vehicle design, materials selection, construction, operation, and maintenance. It is an important trade within industrial technical education, with

programs in tertiary institutions aimed at producing skilled technologists (Poripo, 2025 & 2024). According to Poripo, (2025) & National Board for Technical Education (NBTE, 2003), a motor vehicle mechanic must be competent in testing, diagnosing, servicing, and repairing automobile systems in line with manufacturers' specifications. Similarly, Poripo et al. (2020) emphasize that automobile education involves not only technical training but also the acquisition of scientific knowledge and problem-solving skills needed for industrial and engineering development. At the technical college level, this trade includes three core components: Service Station Mechanic Work, Engine Maintenance and Refurbishing, and Auto Electricity. According to Welbur (1999), a motor vehicle mechanic is a person engaged in diagnosing or repairing faulty vehicle components or systems for compensation. Essentially, they handle engine, transmission, differential, steering, suspension, and brake systems within their business enterprises commonly referred to as automobile enterprises (Abdulkadir, et al, 2022).

An automobile enterprise, in this study, refers to a workshop or garage equipped with tools and machinery used by mechanics for motor vehicle maintenance. Olaitan & Keh (2015) describe it as a privately owned mechanical workshop established by master craftsmen for self-employment and job creation. Automobile enterprises also offer other business opportunities, including spare parts sales, auto body repair and painting, electrical work, and panel beating.

Maintenance refers to the repair activities performed to keep machinery or vehicles functional or restore them to their original condition (Okah-Avae, 1995; Akinola & Ogedengbe, 2005). Narayan, (2004) added that it involves preventive actions to ensure maximum service life of equipment. In this context, maintenance entails adherence to manufacturer-prescribed service schedules and emission standards. Given the sophistication of modern vehicles, mechanics must acquire emerging maintenance competencies to handle repairs beyond conventional mechanical skills by craftsmen and technicians (Abdulkadir, et al, 2022).

In this study, Motor Vehicle Craftsmen are-skilled hands-on workers that focused on fabrication, assembly, and installation of vehicles. While Technician applies theory to practice through testing, troubleshooting, and maintenance of motor vehicles. Also, Technologist bridges the gap between engineers and technicians, handling applied design and supervision. The motor vehicle Engineers focuses on conceptual design, innovation, and system integration at the highest level of motor vehicle and its maintenance competency.

Maintenance competency refers to specialized technical proficiency in applying methods, tools, and processes for production or service delivery (Osinem, 2008). In the automotive sector, emerging maintenance competencies involve new skills required to diagnose and repair modern vehicles as specified by manufacturers. Modern vehicles, as noted by Nna (2001), incorporate embedded electronic systems and controls that demand specialized diagnostic tools such as On-Board Diagnostic (OBD) scanners. Abubakar, el ta, (2015) identified that new technologies particularly affect vehicle fuel, ignition, and transmission systems.

A fuel system is a critical component of a vehicle that stores and delivers fuel to the

engine for combustion, ensuring optimal performance and efficiency. A fuel system is responsible for supplying the right amount of fuel to the engine, where it is mixed with air, vaporized, and ignited to produce power (Abdulkadir, et al, 2022). The system consists of several key components that work together to ensure efficient fuel delivery and engine performance. For instance, early fuel systems relied on mechanical pumps and carburetors (Salami, 2004), while modern systems are electronically monitored and controlled (Julian, 2015). Similarly, Electronic ignition systems are advanced ignition systems that use electronic components to generate a high-voltage spark for igniting the air-fuel mixture in internal combustion engines, offering improved performance and efficiency over traditional systems. An electronic ignition system is a type of ignition system that utilizes electronic components, such as transistors and sensors, to control the timing and generation of the spark needed to ignite the air-fuel mixture in an engine. This system replaces the older mechanical ignition systems, which relied on contact points and distributors electronic ignition systems now include trigger wheels, pickup coils, and Electronic Control Units (ECU) (Salami, 2007). A transmission system is a mechanism that transfers power from a source, such as an engine, to the wheels or other components, enabling movement and control in vehicles and various machinery.

In the context of automobiles, the transmission system is crucial for transferring the power generated by the engine to the wheels. Transmission systems have evolved from manual gearboxes to ECU-controlled automatic and continuously variable transmissions (Giri, 2013).

These developments underscore that modern automobile integrate both mechanical and digital technologies, requiring mechanics to handle both traditional and computerized systems. However, many local mechanics face challenges diagnosing and repairing modern vehicles due to limited exposure to new technologies (Aruku, 2007; Nyapson, 2015). Consequently, many workshops in Nigeria struggle to manage electronically controlled vehicles. Therefore, this study seeks to identify the emerging maintenance competencies needs for improve Automobile Enterprises by Motor Vehicle Mechanics in Yenagoa, Bayelsa State, Nigeria, to successfully establish and manage automobile enterprises.

Purpose of the Study

The general aim of the study was to identify the emerging maintenance competencies needs for improve Automobile Enterprises by Motor Vehicle Mechanics in Yenagoa, Bayelsa State. Specifically, it sought to:

1. Identify the emerging maintenance competencies needed for maintaining the fuel system.
2. Identify the emerging maintenance competencies needed for maintaining the transmission system.

Research Questions

1. What emerging maintenance competencies do motor vehicle mechanics need for maintaining the fuel system when establishing automobile enterprises?
2. What emerging maintenance competencies do motor vehicle mechanics need for maintaining the transmission system when establishing automobile enterprises?

Hypotheses

1. master craftsmen and automobile industrial technicians regarding the competencies needed for maintaining fuel systems.
2. There is no significant difference between the mean responses of master craftsmen and automobile industrial technicians regarding the competencies needed for maintaining transmission systems.

METHODS

The study employed a descriptive survey design and was conducted in Yenagoa, Bayelsa State. The population of the study comprised of 140 motor vehicle mechanic master craftsmen and 14 automobile industrial technicians selected through random sampling technique. Making a total of 154 respondents. The instrument used for data collection was adapted by the researcher, it is a structured questionnaire titled: Automobile Enterprises Emerging Technology Competencies Questionnaire (AEETCQ), the instrument has 2 sections, with section A contain 23 items while section B contains 21 items, making a total of 44 items. Responses were rated on a four-point scale: Highly Needed (4), Needed (3), Moderately Needed (2), and Not Needed (1). The instrument was validated by three experts. The reliability coefficient of the instrument was embellished using Cronbach's Alpha reliability test, the reliability coefficient was 0.86 and 0.84 with reliability index of 0.85. Data analysis was conducted using SPSS Version 23. Mean and Standard Deviation were used to answer the research questions and t-test statistics was used to test the null hypotheses at 0.05 level of significance. Decisions were based on p-values, with hypotheses rejected when $p < 0.05$ and accepted when $p \geq 0.05$. Reliability testing produced a coefficient of 0.85 using Cronbach's Alpha.

RESEARCH RESULTS

Research Question 1

What are the emerging maintenance competencies needed by motor vehicle mechanics in the maintenance of fuel system for the establishment of automobile enterprise?

Table 1

Mean and Standard Deviation on the Emerging Maintenance Competencies Needed by Motor Vehicle Mechanics in the Maintenance of Fuel System for the Establishment of Automobile Enterprise

S/No	Items	N	Mean	SD	Decision
1	Ability to remove fuel injection fuel rail.	154	3.51	0.33	Highly Needed
2	Ability to remove pressure regulator.	154	3.53	0.25	Highly Needed
3	Removing and replacing electronics faulty injectors.	154	3.56	0.25	Highly Needed
4	Replacing new O-ring onto new injector.	154	3.51	0.35	Highly Needed
5	Undertaking visual inspection of the air mass sensor.	154	3.57	0.19	Highly Needed
6	Checking for leakages in induction and exhaust system.	154	3.68	0.01	Highly Needed

7	Using multi-meter to check for oxygen sensor.	154	3.65	0.35	Highly Needed
8	Checking the oxygen sensor for possible damage.	154	3.64	0.13	Highly Needed
9	Ability to check malfunction indicator or lamp.	154	3.57	0.19	Highly Needed
10	Competency in checking fuel injector using multi-meter.	154	3.63	0.94	Highly Needed
11	Competency in checking fuel pump and its circuits.	154	3.61	0.12	Highly Needed
12	Checking pressure sensor and power control module.	154	3.51	0.12	Highly Needed
13	Using scan tool to check for fuel pressure by controlling the of the pump.	154	3.68	0.01	Highly Needed
14	Competency in undertaking throttle actuator inspection.	154	3.56	0.20	Highly Needed
15	Ability to use fuel calibration machine to determine fuel consumption by the engine.	154	3.64	0.13	Highly Needed
16	Testing gasoline engines for functional sensors.	154	3.59	0.30	Highly Needed
17	Checking and adjusting the idling speed.	154	3.52	0.25	Highly Needed
18	Using multi-meter to test run fuel system so as to clear the trouble codes.	154	3.64	0.23	Highly Needed
19	Using vehicle communication kit to check fuel injection malfunction.	154	3.61	0.27	Highly Needed
20	Interpretation of the printed fuel system diagnostics codes.	154	3.53	0.28	Highly Needed
21	Undertaking the maintenance of fuel system circuit.	154	3.54	0.23	Highly Needed
22	Competency in proper injector cleaning.	154	3.51	0.28	Highly Needed
23	Competency in inspecting all under hood wiring.	154	3.58	0.32	Highly Needed
	Grand Mean/SD		**3.52**	**0.34**	**Highly Needed**

Note*: N = Number of Respondents, SD = Standard Deviation*

The results in Table 1 shows that the respondents agreed with all the items with grand mean of 3.52 as emerging maintenance competencies needed by motor vehicle mechanics in the maintenance of fuel system for the establishment of automobile enterprises.

Research Question 2

What are the merging maintenance competencies needed by motor vehicle mechanics in the maintenance of transmission system for the establishment of automobile enterprise?

Table 2

Mean and Standard Deviation on the Emerging Maintenance Competencies Needed by Motor Vehicle Mechanics in the Maintenance of Transmission System for the Establishment of Automobile Enterprise

S/No	Items	N	Mean	SD	Decision

1	Competency in checking repairing all-wheel drive system.	154	3.53	0.92	Highly Needed
2	Ability to repair auto-active automatic transmission	154	3.67	0.03	Highly Needed
3	Competency in repairing trans- axle transmission	154	3.66	0.20	Highly Needed
4	Ability to service continuously variable transmission	154	3.56	0.20	Highly Needed
5	Checking fluid coupling for fluid leakages.	154	3.61	0.27	Highly Needed
6	Checking fluid coupling for torque converter leakages	154	3.53	0.09	Highly Needed
7	Replacing faulty torque converter.	154	3.55	0.21	Highly Needed
8	Replacing defective fluid lines and fittings.	154	3.58	0.31	Highly Needed
9	Servicing automated manual transmission	154	3.58	0.31	Highly Needed
10	Carrying out road test for proper gear engagement.	154	3.55	0.21	Highly Needed
11	Ability to check transmission vent for blockage.	154	3.53	0.90	Highly Needed
12	Ability to replace O-ring and gears.	154	3.50	0.34	Highly Needed
13	Inspecting entire transmission wiring harness for tears.	154	3.52	0.35	Highly Needed
14	Ability to inspect and adjust shift cable.	154	3.59	0.29	Highly Needed
15	Checking the drive train for looseness and leaks.	154	3.55	0.35	Highly Needed
16	Checking fluid level for leakages from the transmission vent.	154	3.53	0.90	Highly Needed
17	Ability to retrieve transmission diagnostic trouble code.	154	3.68	0.01	Highly Needed
18	Ability to record printed transmission diagnostic trouble code.	154	3.58	0.01	Highly Needed
19	Ability to interpret transmission diagnostic trouble code.	154	3.58	0.31	Highly Needed
20	Replacing new gasket to correct fluid leakage.	154	3.52	0.93	Highly Needed
21	Check and inspect Traction Control System	154	3.52	0.35	Highly Needed
	Grand Mean/SD		**3.52**	**0.33**	**Highly Needed**

Note: *N = Number of Respondents, SD = Standard Deviation*

The analysis in Table 2 shows that the respondents agreed with all the items with grand mean of 3.52 as emerging maintenance competencies highly needed by motor vehicle mechanics in the maintenance of transmission system for the establishment of automobile enterprises.

Table 3

Mean score of master craftsmen and technicians on the emerging maintenance

competencies needed by motor vehicle mechanics in the maintenance of fuel system for the establishment of automobile enterprise

Motor vehicle mechanics	N	Mean	S.D	Df	Z	P-value
Motor vehicle mechanic master craftsmen	140	3.24	0.76	153	-.467	.641
Automobile industrial technicians	14	3.29	0.61			

Result in Table 3 revealed that there is no significant difference (P<.05) in the mean score of the respondents. Z (153) = -.467, p = .641. Therefore, the null hypothesis was accepted indicating that there was no significant difference between the mean response of motor vehicle mechanic and automobile industrial technicians on maintenance of fuel systems for establishing automobile enterprises in Yenagoa, Bayelsa State.

Table 4

mean scores of master craftsmen and technicians on the emerging maintenance competencies needed by motor vehicle mechanics in the maintenance of transmission system for the establishment of automobile enterprise

Motor vehicle mechanics	N	Mean	S.D	Df	Z	P-value
Motor vehicle mechanic master craftsmen	140	3.18	0.77	153	-.395	.693
Automobile industrial technicians	14	3.23	0.65			

Table 4 revealed that there is no significant difference (P<.05) in the mean score of the respondents. Z (153) = -.395, p = .693. Therefore, the null hypothesis was accepted indicating that there was no significant difference between the mean response of motor vehicle mechanic and automobile industrial technicians on maintenance of transmission systems for establishing automobile enterprises in Yenagoa, Bayelsa State.

Discussion

The results presented in Table 1, which addressed research question 1, indicated that respondents agreed on all the listed emerging maintenance competencies required by motor vehicle mechanics for maintaining fuel systems in the establishment of automobile enterprises. Specifically, the study revealed that mechanics need the skill to test fuel injectors using a multi-meter. This aligns with Abdulkadir, et al, (2022) & Schutte et al. (2004), who explained that the primary function of a multi-meter in this context is to detect the voltage signals of injectors to assess fuel flow. Similarly, Allen & Derek (2012) emphasized that the electrical component of a petrol injector consists of a wire coil with a known resistance, and any malfunction—such as poor connections or partial short circuits-can be diagnosed using a multi-meter or ohmmeter to test the injector's electrical condition.

Findings showed that mechanics require proficiency in testing fuel injectors using

multi-meters, consistent with Schutte, et al. (2004), who emphasized voltage detection for injector function. Moreso, Allen & Derek (2012), noted the multi-meter's use in diagnosing electrical faults in injectors. Modern vehicles, as noted by Nna (2001), incorporate embedded electronic systems and controls that demand specialized diagnostic tools such as On-Board Diagnostic (OBD) scanners. Abdulkadir, et al, (2022) & Abubakar, et al, (2015) identified that new technologies particularly affect vehicle fuel, ignition, transmission systems and maintenance.

Table 2, which addressed research question 2, shows that respondents also agreed on the emerging maintenance competencies needed for maintaining ignition systems in automobile enterprises. The findings highlighted that mechanics must be able to use a digital multi meter to test ignition systems. This supports the view of Hella Tech World (2019), who noted that although modern vehicles are equipped with advanced engine management systems, technicians still require multi meters or oscilloscopes to accurately diagnose ignition faults. Effective fault tracing, therefore, depends on mechanics being proficient in using these diagnostic instruments. Furthermore, competence in maintaining auto-active transmission systems was identified as essential. This aligns with Steve (2016), who explained that modern transmissions rely on torque converters and electronic controls rather than manual clutches, requiring advanced diagnostic and servicing skills. Also, this finding is in line with the study of Julian, (2015) who emphasis that modern systems are electronically monitored and controlled. The findings is consistent with the findings of Giri, (2013) who stated that transmission systems have evolved from manual gearboxes to ECU-controlled automatic and continuously variable transmissions.

Conclusion

The study concluded that emerging technological competencies particularly in fuel, ignition, and transmission systems are critically needed by motor vehicle mechanics to establish and effectively manage modern automobile enterprises. Implementing these competencies will produce a generation of highly skilled mechanics capable of maintaining and repairing both traditional and modern vehicles.

Recommendation of the Study

Based on the findings of the study, the following recommendations were made:

1. The National Automotive Design and Development Council (NADDC), in partnership with the Federal Ministry of Labour and Productivity, should incorporate identified emerging maintenance competencies into training and refresher programs for motor vehicle mechanics.
2. The National Board for Technical Education (NBTE) should integrate these competencies into the technical college curriculum to enhance students' preparedness for self-employment and promote the sustainability of automobile enterprises in Nigeria.

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