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**EMERGING TECHNOLOGY COMPETENCIES NEEDED FOR ESTABLISHING  
AUTOMOBILE ENTERPRISES BY MOTOR VEHICLE MECHANICS IN FEDERAL  
CAPITAL TERRITORY ABUJA, NIGERIA**

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## **EMERGING TECHNOLOGY COMPETENCIES NEEDED FOR ESTABLISHING AUTOMOBILE ENTERPRISES BY MOTOR VEHICLE MECHANICS IN FEDERAL CAPITAL TERRITORY ABUJA, NIGERIA**

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**Abstract**

*The study was designed to investigate the emerging technology competencies needed for establishing automobile enterprises by Motor Vehicle Mechanics (MVM) in Federal Capital Territory (FCT) Abuja, Nigeria. Three research questions were answered, and three null hypotheses guided the study. A descriptive research design was employed for the study. The study was carried out in FCT, Abuja Nigeria. A total of 854 respondents comprising of 810 motor vehicle mechanic master craftsmen were drawn using a proportional stratified random sampling technique and 44 automobile industrial technicians were used as the total population for the study. A structured questionnaire developed by the researchers and validated by three experts was used for the data collected for the study. Cronbach Alpha statistics was used to determine the reliability coefficient of the instrument and the result was found to be 0.85. Mean and standard deviation were to answer the research questions while z-test statistics was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed among others that all the identified emerging technology competencies in the study were highly needed by MVM for establishing automobile enterprises in FCT, Abuja Nigeria. Based on the findings it was recommended that the National Automotive Design and Development Council (NADDC) in collaboration with the Federal Ministry of Labour and Productivity and National Board for Technical Education (NBTE) incorporate the identified emerging technology competencies needed by MVM in their training programmes and curriculum as this will expose them to innovations in modern automobiles.*

### **Introduction**

Motor vehicle mechanic (MVM) is one of the mechanical engineering trades which involve the acquisition of scientific knowledge in design, selection of materials, construction, operation, and maintenance of motor vehicles. MVM work-trade at the Technical College (TC) level consists of three components/subjects grouped as Service Station Mechanic Work, Engine Maintenance and Refurbishing and Auto Electricity. Welbur (1999) described MVM as a person who, for compensation, engages in the diagnosis or repair of faulty motor vehicles components or systems. This means that motor vehicle mechanics are responsible for the service and repair of motor vehicles including undertaking work on engine, transmission, differential, steering, suspension, and brakes in their business enterprises which can be operated as automobile enterprises.

Automobile enterprise in the context of this study refers to a designated place or room where workbenches, mechanical toolboxes and other basic vehicle maintenance and repair tools and standard equipment are used for vehicle maintenance by motor vehicle mechanics. However, Olaitan and Ikeh (2015) automobile enterprise refer to independent vehicle maintenance mechanic workshops or garages set up by MVM master craftsmen under private ownership for self-employment and employing others. Although automobile industrial technicians most at times serve to complement the efforts of MVM master craftsmen in terms of maintenance and repairs of modern vehicles in the automobile industry. Notwithstanding, other businesses opportunities available in an automobile enterprise include car dealership, spare parts distribution, and jobbers. In other words, activities such as Auto body repair and spraying and painting, auto electrical work, Auto body mechanic work and Auto body building (panel beating) are also available in automobile enterprises for maintenance and repairs.

Maintenance is a repair activity carried out on vehicles or other types of machinery to keep them unaltered, and if altered, to restore them to their original state (Akinola & Ogedengbe, 2005). Narayan (2004) also stated that maintenance involves taking specific approved steps and precautions to care for a piece of equipment, machinery or facility and ensure it attains its maximum shelf-life. In the context of this study, maintenance is the adherence to the manufacturer's schedule for vehicle upkeep plus the repair of systems or faults that have led to excess emissions. This also means that mechanics generally needed to be equipped with emerging technology competencies necessary for the maintenance and repairs of modern vehicles; this is because conventional technology competencies already possessed by them cannot take care of emerging technologies on modern vehicles.

Emerging technology competencies in motor vehicle mechanics, however, refer to a new set of competencies needed by MVM for the maintenance and repairs of modern vehicles according to the manufacturers' specifications. According to Nna (2001), today's modern vehicles contain more embedded electronic components and controls that require a higher degree of sophistication for testing and servicing, as well as special On-Board Diagnostic (OBD) tools and test instruments. Although Parts of these modern vehicle system and subsystem affected by emerging technologies according to Abubakar, Yahaya and Tijana (2015) includes: Fuel system, Ignition system and Transmission system. The main function of the fuel system is to store and supply fuel to the engine. Giri (2010) stated that the fuel supply system also prepares the air/fuel mixture for the combustion in the cylinder and carries the exhaust gas to the rear of the vehicle. The early vehicle fuel systems were completely mechanical systems delivering fuel using a mechanical fuel pump and a carburettor to atomize and mix the fuel with air (Salami, 2004). The modern vehicle fuel system according to Julian (2015) is electronically controlled and monitored. Accordingly, the ignition system provides the spark necessary to ignite the air/fuel mixture inside the engine for it to burn. The spark must be provided at the correct time and sequence to the various cylinders to produce maximum horsepower with the least amount of fuel thus emitting the lowest number of harmful emissions (Salami, 2007). The basic components of an electronic ignition system include a trigger wheel, pick up coil and electronic control unit amplifier (ECU). The transmission system on the other hand conveys the power developed by the engine crankshaft to the driving road wheels. Giri (2013) claimed that conventional transmission system consists of the following: clutch, gearbox, sliding joint, universal joint, propeller shaft, universal joint, and differential units. The transmission system could be manually or automatically operated. However, a Modern transmission system equipped with ECU for gear selection as well as clutch control is made automatically by the ECU.

Today, the designs of modern vehicles have advanced to a very sophisticated level. Unlike the old mechanical operated vehicle systems, modern vehicles are being operated and controlled by computerized electrical sensors. Hence, despite all emerging technologies on modern vehicles, the business of motor vehicle mechanics in automobile enterprises should be to undertake the maintenance and repairs of both conventional vehicles and modern vehicles equipped with integrated electronic systems and computers. MVM either operates as paid employees in the automobile industry and other organizations or as self-employed in their enterprises in the automobile world of work.

However, it has been observed that most MVM who generally enjoyed the regular flow of customers for effective maintenance and repairs of conventional vehicles are now faced with the challenges of how to either troubleshoot or fully undertake the maintenance and repairs of modern vehicles. Aruku (2007) stipulated that with sophistication in modern vehicles due to advancement in technology, the artisans, as well as the motor vehicle master craftsmen, are finding it difficult to handle repairs of faults in a motor vehicle generally and the new vehicles specifically. Nyapson (2015) pointed out that, MVM cannot compete favourably in the global workforce due to a lack of appropriate skills in testing, diagnosing, servicing and completely repairing faults on a modern vehicle according to the manufacturer's specification. This situation has made most automobile enterprises established by MVM a dumping ground for these modern vehicles that seem to have either developed minor or major mechanical and electronic problems.

The forgoing might not be unconnected with the fact that these MVM in FCT, Abuja, do not possess the technical know-how to undertake maintenance and repairs of modern vehicles, but seems to be faced with the lack of emerging technology competencies needed to fully undertake the maintenance and repairs. Against this background, this study, therefore, posed to identify the emerging technology competencies needed for establishing an automobile enterprise by MVM in FCT, Abuja, Nigeria.

## Research Objective

This study examined the emerging technology competencies needed for establishing an automobile enterprise by MVM in FCT, Abuja, Nigeria.

## Research Questions

1. What are the emerging technology competencies needed by motor vehicle mechanics in the maintenance of fuel systems for the establishment of automobile enterprise?
2. What are the emerging technology competencies needed by motor vehicle mechanics in the maintenance of ignition systems for the establishment of an automobile enterprise?
3. What are the emerging technology competencies needed by motor vehicle mechanics in the maintenance of transmission systems for the establishment of automobile enterprises?

## Research Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

1. **H<sub>01</sub>:** There is no significant difference in the mean responses of motor vehicle mechanic master craftsmen and automobile industrial technicians as regards the emerging technology competencies needed by motor vehicle mechanics in the maintenance of fuel systems for the establishment of automobile enterprise.
2. **H<sub>02</sub>:** There is no significant difference in the mean responses of motor vehicle mechanic master craftsmen and automobile industrial technicians as regards the emerging technology competencies needed by motor vehicle mechanics in the maintenance of ignition systems for the establishment of automobile enterprise.
3. **H<sub>03</sub>:** There is no significant difference in the mean responses of motor vehicle mechanic master craftsmen and automobile industrial technicians as regards the emerging technology competencies needed by motor vehicle mechanics in the maintenance of transmission systems for the establishment of automobile enterprise.

## Research Methodology

A descriptive research design was employed for the study. The study was carried out in FCT, Abuja Nigeria. A total of 854 respondents comprising of 810 MVM master craftsmen drawn from a total number of MVM master craftsmen that was 8,100 using a proportional stratified random sampling technique and 44 automobile industrial technicians was used as a total population for the study. A structured questionnaire titled Automobile Enterprises Emerging Technology Competencies Questionnaire (AEETCQ) developed by the researchers and validated by three experts was used for the data collected for the study. The reliability coefficient of the instrument was 0.85 through Cronbach Alpha statistics: Statistical Package for Social Science (SPSS Version 23) was used for the data analysis. 854 copies of the questionnaire were distributed to respondents; 779 copies were duly filed by the respondents and returned representing 91.2%. Mean and standard deviation were the statistical tools for answering research questions while z-test statistics was used to test the null hypotheses at .05 level of significance. The decisions for research questions were based on the resulting mean scores interpreted relative to the concept of real lower and upper limits of numbers as follows: 3.50 – 4.00 as Highly Needed (HN); 2.50 – 3.49 as Needed (N); 1.50 – 2.49 as Moderately Needed (MN) and 0.50 – 1.49 as Not Needed (NN). Accordingly, the decisions on the null hypotheses formulated for the study were based on comparing the significant value with ( $P < .05$ ) level of significance; that is where the significant value is less than ( $P < .05$ ) it was rejected, while equal or greater than ( $P < .05$ ) level of significance, the hypothesis was upheld and accepted.

## Results

**Research Question 1:** What are the emerging technology competencies needed by motor vehicle mechanics in the maintenance of fuel systems for the establishment of an automobile enterprise?

**Table 1**

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

N= 854

S/No	Items	Mean	SD	Decision
1	Ability to remove fuel injection fuel rail.	3.51	0.33	Highly Needed
2	Ability to remove pressure regulator.	3.53	0.25	Highly Needed
3	Removing and replacing electronics faulty injectors.	3.56	0.25	Highly Needed
4	Replacing new O-ring onto a new injector.	3.51	0.35	Highly Needed
5	Undertaking visual inspection of the air mass sensor.	3.19	0.30	Needed
6	Checking for leakages in induction and exhaust system.	3.16	0.34	Needed
7	Using a multimeter to check for oxygen sensor.	3.65	0.35	Highly Needed
8	Checking the oxygen sensor for possible damage.	3.30	0.14	Needed
9	Ability to check malfunction indicator or lamp.	3.57	0.19	Highly Needed
10	Competency in checking fuel injectors using a multimeter.	3.63	0.94	Highly Needed
11	Competency in checking fuel pump and its circuits.	3.61	0.12	Highly Needed
12	Checking pressure sensor and power control module.	3.51	0.12	Highly Needed
13	Using scan tool to check for fuel pressure by controlling the of the pump.	3.68	0.01	Highly Needed
14	Competency in undertaking throttle actuator inspection.	3.56	0.20	Highly Needed
15	Ability to use a fuel calibration machine to determine fuel consumption by the engine.	3.64	0.13	Highly Needed
16	Testing gasoline engines for functional sensors.	3.59	0.30	Highly Needed
17	Checking and adjusting the idling speed.	3.52	0.25	Highly Needed
18	Using a multimeter to test run fuel system to clear the trouble codes.	3.64	0.23	Highly Needed
19	Using vehicle communication kit to check fuel injection malfunction.	3.61	0.27	Highly Needed
20	Interpretation of the printed fuel system diagnostics codes.	3.53	0.28	Highly Needed
21	Undertaking the maintenance of the fuel system circuit.	3.54	0.23	Highly Needed
22	Competency in proper injector cleaning.	3.51	0.28	Highly Needed
23	Competency in inspecting all under hood wiring.	3.58	0.32	Highly Needed
<b>Grand Mean/SD</b>		<b>3.52</b>	<b>0.34</b>	<b>Highly Needed</b>

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

Analysis in Table 1 showed that the respondents agreed with all the items with a grand mean of 3.52 as emerging technology competencies needed by motor vehicle mechanics in the maintenance of fuel systems for the establishment of automobile enterprises.

**Research Question 2:** What are the emerging technology competencies needed by motor vehicle mechanics in the maintenance of ignition systems for the establishment of an automobile enterprise?

**Table 2**

*Mean and Standard Deviation of Opinion of Respondents on the Emerging Technology Competencies Needed by Motor Vehicle Mechanics in the Maintenance of Ignition System for the Establishment of Automobile Enterprise*

<b>S/No</b>	<b>Items</b>	<b>Mean</b>	<b>SD</b>	<b>Decision</b>
1	Ability to use a digital multimeter to record Ignition timing.	3.51	0.27	Highly Needed
2	Performing magnetic sensor testing.	3.56	0.04	Highly Needed
3	Use of multimeter to test the ignition system.	3.50	0.28	Highly Needed
4	Use of adapter or plug wire to check spark.	3.31	0.12	Needed
5	Using a diagnostic tool to check for the crank sensor.	3.65	0.35	Highly Needed
6	Identification of ignition problem.	3.55	0.21	Highly Needed
7	Ability to print recorded ignition diagnostics trouble codes	3.57	0.19	Highly Needed
8	Ability to retrieve ignition diagnostics trouble codes.	3.60	0.28	Highly Needed
9	Interpretation of ignition diagnostics trouble codes.	3.69	0.30	Highly Needed
10	Testing and diagnosing faulty reluctor sensor.	3.51	0.01	Highly Needed
11	Using multimeter and oscilloscope for voltage and signal supply.	3.66	0.20	Highly Needed
12	Inspect and adjust faulty crank position sensor.	3.55	0.35	Highly Needed
13	Checking both crankshaft and camshaft sensors and their wiring for possible damage.	3.69	0.30	Highly Needed
14	Ability to inspect, repair and replace faulty electronic ignition components.	3.55	0.21	Highly Needed
15	Checking the battery for enough voltage needed to crank the engine.	3.15	0.35	Needed
16	Electronic Ignition system	3.55	0.35	Highly Needed
17	Distributor less ignition	3.65	0.35	Highly Needed
18	Electronic Force Distribution	3.61	0.12	Highly Needed
<b>Grand Mean/SD</b>		<b>3.55</b>	<b>0.24</b>	<b>Highly Needed</b>

Analysis in Table 2 revealed that the respondents agreed with all the items with a grand mean of 3.55 as emerging technology competencies needed by motor vehicle mechanics in the maintenance of ignition systems for the establishment of automobile enterprises.

**Research Question 3:** What are the merging technology competencies needed by motor vehicle mechanics in the maintenance of transmission systems for the establishment of automobile enterprise?

**Table 3**

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

S/No	Items	Mean	SD	Decision
1	Competency in checking to repair all-wheel-drive system.	3.53	0.92	Highly Needed
2	Ability to repair auto-active automatic transmission	3.67	0.03	Highly Needed
3	Competency in repairing trans-axle transmission	3.66	0.20	Highly Needed
4	Ability to service continuously variable transmission	3.56	0.20	Highly Needed
5	Checking fluid coupling for fluid leakages.	3.61	0.27	Highly Needed
6	Checking fluid coupling for torque converter leakages	3.53	0.09	Highly Needed
7	Replacing faulty torque converter.	3.55	0.21	Highly Needed
8	Replacing defective fluid lines and fittings.	3.58	0.31	Highly Needed
9	Servicing automated manual transmission	3.58	0.31	Highly Needed
10	Carrying out road tests for proper gear engagement.	3.20	0.28	Needed
11	Ability to check transmission vent for blockage.	3.20	0.28	Needed
12	Ability to replace O-ring and gears.	3.50	0.34	Highly Needed
13	Inspect the entire transmission wiring harness for tears.	3.10	0.34	Needed
14	Ability to inspect and adjust shift cable.	3.59	0.29	Highly Needed
15	Checking the drive train for looseness and leaks.	3.55	0.35	Highly Needed
16	Checking fluid level for leakages from the transmission vent.	3.53	0.90	Highly Needed
17	Ability to retrieve transmission diagnostic trouble code.	3.68	0.01	Highly Needed
18	Ability to record printed transmission diagnostic trouble code.	3.58	0.01	Highly Needed
19	Ability to interpret transmission diagnostic trouble code.	3.58	0.31	Highly Needed
20	Replacing a new gasket to correct fluid leakage.	3.52	0.93	Highly Needed
21	Check and inspect Traction Control System	3.52	0.35	Highly Needed
<b>Grand Mean/SD</b>		<b>3.52</b>	<b>0.33</b>	<b>Highly Needed</b>

Analysis in Table 3 showed that the respondents agreed with all the items with a grand mean of 3.52 as emerging technology competencies needed by motor vehicle mechanics in the maintenance of transmission systems for the establishment of automobile enterprises.

### Hypothesis Testing

**Table 4**

*Z – test of difference between the mean scores of motor vehicle mechanic master craftsmen and automobile industrial technicians on the emerging technology competencies needed by motor vehicle mechanics in the maintenance of fuel systems for the establishment of automobile enterprise*

Motor vehicle mechanics	N	Mean	SD	df	Z	P-value
Motor vehicle mechanic master craftsmen	810	3.24	0.76	852	-.467	.641
Automobile industrial technicians	44	3.29	0.61			

Table 4. revealed that there is no significant difference ( $P < .05$ ) in the mean score of the respondents.  $Z(582) = -.467$ ,  $p = .641$ . Therefore, the null hypothesis was accepted indicating that there was no significant difference between the mean response of motor vehicle mechanics and automobile industrial technicians on maintenance of fuel systems for establishing automobile enterprises in FCT, Abuja.

**Table 5**

*Z – test of difference between the mean scores of motor vehicle mechanic master craftsmen and automobile industrial technicians on the emerging technology competencies needed by motor vehicle mechanics in the maintenance of ignition systems for the establishment of automobile enterprise*

<b>Motor vehicle mechanics</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>df</b>	<b>Z</b>	<b>P-value</b>
Motor vehicle mechanic master craftsmen	810	3.26	0.79	852	-.458	.647
Automobile industrial technicians	44	3.32	0.65			

Table 5 revealed that there is no significant difference ( $P < .05$ ) in the mean score of the respondents.  $Z (582) = -.458$ ,  $p = .647$ . Therefore, the null hypothesis was accepted indicating that there was no significant difference between the mean response of motor vehicle mechanics and automobile industrial technicians on maintenance of ignition systems for establishing automobile enterprises in FCT, Abuja.

**Table 6**

*Z – test of difference between the mean scores of motor vehicle mechanic master craftsmen and automobile industrial technicians on the emerging technology competencies needed by motor vehicle mechanics in the maintenance of transmission systems for the establishment of automobile enterprise*

<b>Motor vehicle mechanics</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>df</b>	<b>Z</b>	<b>P-value</b>
Motor vehicle mechanic master craftsmen	810	3.18	0.77	852	-.395	.693
Automobile industrial technicians	44	3.23	0.65			

Table 6 revealed that there is no significant difference ( $P < .05$ ) in the mean score of the respondents.  $Z (582) = -.395$ ,  $p = .693$ . 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 FCT, Abuja.

## Discussion

The findings in Table 1 relating to research question 1 showed that respondents agreed with all the items on the emerging technology competencies needed by motor vehicle mechanics in the maintenance of fuel systems for establishing automobile enterprises. The findings revealed that motor vehicle mechanics needs the ability to check fuel injectors using a multimeter. This conforms with the opinion of Schutte *et al.* (2004) who stated that the principal idea in the use of multimeter was to detect the voltage signals of the injectors to determine the flow of the fuel. This finding was further corroborated by Allen and Derek (2012) who asserted that the electrical part of a petrol injector consists of a wire coil that has a known resistance. If there is a problem with the injector it may be due to a poor connection or a partial short-circuit, either way, a multimeter/ohmmeter will be used to test the condition of the electrical part of the injector.

The findings in Table 2 relating to research question 2 showed that respondents agreed with all the items on the emerging technology competencies needed by motor vehicle mechanics in the maintenance of ignition systems for establishing automobile enterprises. The findings revealed that motor vehicle mechanics needs the ability to use a digital multimeter to test ignition system. This agrees with the work of Hella Tech World (2019) who maintained that although diagnosable engine management systems are installed in today's vehicles, a multimeter or oscilloscope must be used when checking ignition systems. To trace faults, a technician needs to be equipped with the right skills to use instruments like multimeters and oscilloscopes.

The findings in Table 3 relating to research question 3 showed that respondents agreed with all the items on the emerging technology competencies needed by motor vehicle mechanics in the maintenance of transmission systems for establishing automobile enterprises. The findings revealed that competency to maintain an auto-active transmission system is needed by motor vehicle mechanics. This is inconsonant with the findings of Steve (2016) who explained that modern auto-active transmissions use a hydraulic fluid coupling called torque converter instead of a foot-operated friction clutch to change gears by locking and unlocking a set of planetary gears. It also stops the engine from stalling when a vehicle is stationary and in gear.

## Conclusion

This study determined the emerging technology competencies needed for establishing automobile enterprises by motor vehicle mechanics in Federal Capital Territory, Abuja, Nigeria. The findings of the study serve as the basis for making the following conclusion: That all the emerging technology competencies on the fuel system, ignition system and transmission system are highly needed by motor vehicle mechanics for the establishment of automobile enterprises. Accordingly, if the findings of this study are effectively utilized a batch of highly skilled motor vehicle mechanic craftsmen in undertaking the maintenance and repairs of modern automotive will be produced.

## Recommendations

Based on the findings, it was recommended that the National Automotive Design and Development Council (NADDC) charged with the responsibility of organizing training and refresher programmes for motor vehicle mechanics should in collaboration with the Federal Ministry of Labour and Productivity incorporate the identified emerging technology competencies needed by motor vehicle mechanics in their training programmes as this will expose them to innovations in modern automobiles and thus boost their performances in the area of undertaking the repairs and maintenance of the modern vehicle in their enterprises.

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