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ASSESSMENT OF THE READINESS OF AUTOMOBILE WORKSHOPS FOR ELECTRIC VEHICLE MAINTENANCE IN KANO STATE, NIGERIA

ABDULLAHI, ABUUBAIDA SHETTIMA, PhD

Department of Technical Education (Automobile Technology), Federal College of Education, Gidan Madi, Sokoto State.

**Corresponding author: abuubaidaabdullahishettima@fcegm.edu.ng*

ABSTRACT

The study assessed the readiness of automobile workshops for electric vehicle (EV) maintenance in Kano State, Nigeria. The study was motivated by the increasing global transition to electric mobility and the need to determine whether automobile workshops possess the technical competence, equipment, and awareness required for effective EV maintenance. Descriptive survey research design was adopted. The population comprised 350 registered automobile workshop owners and technicians in selected Local Government Areas of Kano State. Using the Taro Yamane formula, a sample of 187 respondents was selected through stratified, proportionate and simple random sampling methods. Data were collected using a researcher-developed questionnaire titled Automobile Workshop Readiness for Electric Vehicle Maintenance Questionnaire (AWREVMQ), which had an overall Cronbach's Alpha reliability coefficient of 0.84. Mean and standard deviation were used to analyze the data, with a cut-off mean of 2.50. The findings revealed that respondents perceived automobile technicians to possess adequate overall technical competence (Grand Mean = 2.63), although this competence was largely limited to conventional vehicle maintenance rather than electric vehicle systems. The study further revealed that specialized EV diagnostic tools and equipment were generally unavailable in automobile workshops (Grand Mean = 2.18), indicating low infrastructural readiness. In addition, respondents perceived technicians to have a moderate level of awareness and knowledge of electric vehicle technology (Grand Mean = 2.61), but with limited practical skills and formal training in EV maintenance. The study concluded that automobile workshops in Kano State are not adequately prepared for electric vehicle maintenance due to deficiencies in specialized technical skills, diagnostic facilities, and practical training. It recommended regular capacity-building programmes, integration of EV technology into technical education curricula, increased investment in modern workshop equipment, and stronger collaboration among government, industry, and educational institutions to enhance workshop readiness for the emerging electric mobility sector.

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INTRODUCTION

The global automotive industry is undergoing a rapid transformation driven by technological innovation, environmental concerns, and the need for sustainable transportation systems. One of the most significant

developments in this transition is the emergence and growing adoption of electric vehicles (EVs). Electric vehicles are powered by electric motors using energy stored in rechargeable batteries, replacing the conventional internal combustion engine that relies on fossil fuels. According to the International Energy Agency (IEA, 2023), electric mobility is a key strategy for reducing global carbon emissions and achieving net-zero transportation goals.The shift toward electric vehicles has introduced a new dimension to automotive engineering and maintenance systems.

Unlike conventional vehicles, electric vehicles require specialized maintenance involving high-voltage battery systems, electric drivetrains, power electronics, and advanced software diagnostics. These systems demand highly skilled technicians and sophisticated diagnostic equipment to ensure safety and performance (Chan, 2017; Larminie& Lowry, 2019). Consequently, the maintenance requirements of EVs differ significantly from traditional mechanical systems, making workshop readiness a critical issue in automotive transition planning. Workshop readiness refers to the extent to which automobile service centers possess the necessary infrastructure, technical skills, equipment, and knowledge required to service modern vehicles effectively. In the context of electric vehicles, readiness includes access to diagnostic scanners, insulated tools, charging systems, trained personnel, and compliance with safety standards for high-voltage systems (Ayan&Turkay, 2022). Without these components, workshops may struggle to provide effective maintenance services for EVs, limiting the adoption and reliability of electric mobility systems. In many developing countries, including Nigeria, the automobile service industry is still largely dependent on conventional vehicle technology. Most automobile workshops are designed for internal combustion engine repairs, with limited exposure to electric and hybrid vehicle systems. Studies have shown that the majority of automotive technicians in Nigeria acquire their skills through informal apprenticeship systems, which focus mainly on mechanical repairs rather than modern electronic systems (Oladimeji&Olawale, 2021; Okeke et al., 2023).

The transition to electric vehicles therefore presents a significant skills gap in the Nigerian automotive sector. Technician competence is a major determinant of workshop readiness, as servicing electric vehicles requires knowledge of electrical systems, battery management, and electronic control units. According to UNEP (2022), the lack of technical capacity in developing countries is one of the major barriers to the adoption and maintenance of electric vehicles. Infrastructure availability is another critical factor influencing workshop readiness. Electric vehicle maintenance requires specialized tools such as battery diagnostic equipment, high-voltage safety kits, and software-based diagnostic systems. However, many workshops in Nigeria face challenges such as inadequate investment, poor access to modern equipment, and unstable power supply, which limit their ability to upgrade their facilities (World Bank, 2023; African Development Bank, 2022). Awareness and perception of electric vehicle technology among automobile technicians and workshop owners also play a significant role in adoption readiness.

Limited awareness often results in resistance to new technologies and low investment in training and equipment upgrades. Research indicates that awareness levels strongly influence the willingness of technicians to adopt emerging automotive technologies (Ajayi& Bello, 2024; Rogers, 2003). Kano State, being one of the most industrialized and populous states in northern Nigeria, has a large concentration of automobile workshops serving both private and commercial vehicles. The state plays a vital role in Nigeria's transport and automotive service industry. However, despite its importance, there is limited empirical evidence on the preparedness of automobile workshops in Kano State for electric vehicle maintenance. This creates a knowledge gap that needs to be addressed, especially as Nigeria begins to explore electric mobility initiatives.

This study was anchored on the Human Capital Theory (HCT), developed by Gary Becker (1964). The theory posits that investments in education, training, skills development, and experience enhance individuals' productivity, competence, and ability to perform specialized tasks effectively. According to the theory, organizations and individuals that invest in developing human capital are more likely to achieve higher levels of efficiency, innovation, and competitiveness. The Human Capital Theory is relevant to this study because the maintenance of electric vehicles requires specialized technical knowledge, practical skills, and continuous training that differ significantly from those required for conventional internal combustion engine vehicles. As the automotive industry transitions toward electric mobility, automobile technicians must acquire competencies in high-voltage systems, battery management, electric drive trains, electronic diagnostics, and safety procedures. Workshops must also invest in appropriate equipment and technologies to complement the technical competence of their personnel. The theory therefore explains that the readiness of automobile workshops for electric vehicle maintenance depends not only on the availability of modern tools and facilities but also on the knowledge, awareness, technical skills, and professional competence of technicians. Where technicians receive adequate education and specialized training, they are better equipped to diagnose faults, perform repairs safely, and adapt to emerging automotive technologies. Conversely, inadequate training and limited technical competence reduce workshop readiness and the quality of electric vehicle maintenance services. Consequently, the Human Capital Theory provided a suitable theoretical foundation for this study by demonstrating that continuous investment in technical education, skills acquisition, and professional development is essential for enhancing the preparedness of automobile workshops in Kano State, Nigeria, to effectively maintain electric vehicles.

Furthermore, the challenges affecting workshop readiness are multifaceted. These include high cost of modern diagnostic equipment, lack of government policy enforcement, insufficient technical training programs, limited access to EV technologies, and the low penetration of electric vehicles in the Nigerian market. According to IEA (2023) and African Union (2021), developing countries face significant

barriers in transitioning to electric mobility due to infrastructural and economic limitations. Although several studies have examined electric vehicle adoption, environmental benefits, and technological advancement globally, fewer studies have focused on the readiness of automobile workshops in Nigeria, particularly in Kano State. This highlights a significant research gap in understanding how prepared the automotive service sector is for the emerging electric vehicle market. Therefore, this study seeks to assess the readiness of automobile workshops for electric vehicle maintenance in Kano State, Nigeria.

STATEMENT OF THE PROBLEM

The global transition to electric vehicles (EVs) has created a growing demand for adequate technical skills, specialized equipment, and appropriate infrastructure to support their maintenance and servicing. However, in Nigeria, most automobile workshops remain primarily designed for conventional petrol and diesel vehicles, while many technicians lack the technical training and competencies required for EV maintenance (UNEP, 2022; IEA, 2023). Furthermore, the availability of specialized diagnostic equipment and safety tools for EV servicing is limited, and the level of awareness and preparedness among workshop owners and technicians remains low. This situation is further exacerbated by inadequate training programmes, the high cost of EV maintenance equipment, limited policy support, and the low adoption of electric vehicles in the country (World Bank, 2023). In Kano State, despite the large number of automobile workshops, there is limited empirical evidence regarding their readiness to undertake electric vehicle maintenance.

Therefore, the problem of this study is the uncertainty surrounding the extent to which automobile workshops in Kano State are adequately prepared, in terms of technical skills, equipment, awareness, and infrastructure, to effectively maintain and service electric vehicles.

OBJECTIVES OF THE STUDY

The main purpose of this study is to assess the readiness of automobile workshops for electric vehicle maintenance in Kano State, Nigeria. Specifically, the study seeks to:

1. Determine the level of technical skills and competence of automobile technicians for electric vehicle maintenance in Kano State.

2. Examine the availability of specialized tools and diagnostic equipment required for electric vehicle servicing in automobile workshops.

3. Assess the level of awareness and knowledge of electric vehicle technology among automobile workshop owners and technicians.

RESEARCH QUESTIONS

Based on the purpose of the study, the following research questions were formulated:

1. What are the level of technical skills and competence of automobile technicians for electric vehicle maintenance in Kano State?

2. To what extent are specialized tools and diagnostic equipment for electric vehicle servicing available in automobile workshops in Kano State?

3. What are the level of awareness and knowledge of electric vehicle technology among automobile workshop owners and technicians in Kano State?

METHODOLOGY

The study adopted descriptive survey research design to assess the readiness of automobile workshops for electric vehicle maintenance in Kano State, Nigeria. The design was considered appropriate because it allows the researcher to collect data from respondents and describe their opinions, practices, and conditions as they exist without manipulating any variables.

The study was conducted in Kano Municipal, Fagge, Dala, Tarauni, Nassarawa, and Gwale Local Government Areas, which were selected because they have a high concentration of registered automobile workshops and technicians engaged in vehicle maintenance and repair activities. The population of the study comprised 350 registered respondents, consisting of 70 automobile workshop owners and 280 automobile technicians drawn from selected Local Government Areas in Kano State, Nigeria. The population figure was obtained from the official register of the Kano State Automobile Technicians Association (KSATA) and the records of registered automobile workshops maintained by the association in collaboration with the relevant local government offices (KSATA, 2026). Using the Taro Yamane (1967) sample size determination formula, a sample of 187 respondents was selected. Stratified sampling technique was first employed to classify the population into two strata: automobile workshop owners and automobile technicians. Proportionate sampling was then used to determine the number of respondents selected from each stratum in proportion to its size within the population. Finally, simple random sampling, using computer-generated random numbers, was employed to select the required respondents from each stratum, thereby ensuring that every eligible member had an equal chance of selection while maintaining proportional representation of both groups..

The instrument used for data collection was a researcher-developed questionnaire titled *Automobile*

*Workshop Readiness for Electric Vehicle Maintenance Questionnaire (AWREVMQ***).** The questionnaire was designed based on the objectives of the study and relevant literature on electric vehicle maintenance and workshop readiness. The questionnaire consisted of four sections**.** Section A elicited respondents' demographic information and contained 6 items**.** Section B assessed the technical competence of automobile technicians and workshop owners in electric vehicle maintenance and contained 4 items**.** Section C measured the availability of electric vehicle diagnostic equipment, specialized tools, and workshop facilities and comprised 4 items**.** Section D assessed respondents' awareness of electric vehicle technology and contained 4 items, giving a total of 12 items. The questionnaire adopted a 4-point Likert rating scale of Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1.

The instrument was developed by the researcher and was validated by three experts from the University of Nigeria, Nsukka, comprising two experts in Automobile Technology Education and one expert in Measurement and Evaluation. Their observations and suggestions were incorporated to improve the clarity, relevance, appropriateness, and content validity of the instrument. Data obtained from the pilot study were analyzed using Cronbach's Alpha to determine the internal consistency of the questionnaire. The reliability coefficients obtained were 0.81 for Section B (Technical Competence), 0.84 for Section C (Availability of Diagnostic Equipment and Workshop Facilities), and 0.86 for Section D (Awareness of Electric Vehicle Technology), while the overall Cronbach's Alpha coefficient was 0.84, indicating that the instrument possessed satisfactory reliability for the study. Data collected for the study were analyzed using mean, and standard deviation to answer the research questions. The decision rule for the mean was based on a 4-point Likert scale, where a mean score of 2.50 and above indicated agreement or high level, while below 2.50 indicated disagreement or low level.

RESULTS

The data collected from respondents were analyzed using mean and standard deviation based on the research questions.

Research Question 1*:* What are the level of technical skills and competence of automobile technicians for electric vehicle maintenance in Kano State?

Table 1: Mean responses on Technical Skills and Competence of Automobile Technicians

S/N	Items	(X̄)	Std.	Remark
1	Technicians are skilled in conventional vehicle repair more than EV systems	3.62	0.58	Strongly Agree
2	Technicians have knowledge of electric vehicle high-voltage systems	2.31	0.71	Disagree
3	Technicians are trained in EV battery management systems	2.18	0.66	Disagree
4	Workshops provide training on modern automotive technologies	2.40	0.69	Disagree

Grand Mean = 2.63

Table 1 shows that, based on the cut-off mean of 2.50, respondents perceived automobile technicians to possess adequate overall technical competence (Grand Mean = 2.63). However, the findings further indicate that this competence is largely confined to conventional vehicle repair, while technicians were perceived as lacking adequate knowledge and training in electric vehicle high-voltage systems, EV battery management systems, and modern automotive technologies, as reflected by the mean scores below the cut-off mean.

Research Question 2: To what extent are specialized tools and diagnostic equipment for electric vehicle servicing available in automobile workshops in Kano State?

Table 2: Availability of EV Diagnostic Tools and Equipment

S/N	Items	Mean (X̄)	Std. Dev	Remark
1	EV diagnostic scanners are available in workshops	2.10	0.74	Disagree
2	Battery testing equipment is available	2.05	0.70	Disagree
3	Insulated tools for EV maintenance are available	2.20	0.68	Disagree
4	Workshops have access to modern diagnostic software	2.35	0.72	Disagree

Grand Mean = 2.18

Table 2 shows that respondents perceived electric vehicle diagnostic tools and equipment to be generally unavailable in automobile workshops (Grand Mean = 2.18, which is below the cut-off mean of 2.50). This finding suggests inadequate infrastructural readiness for electric vehicle maintenance in Kano State.

Research Question 3: What are the level of awareness and knowledge of electric vehicle technology among automobile workshop owners and technicians in Kano State?

Table 3: Awareness and Knowledge of EV Technology

S/N	Items	Mean (X̄)	Std. Dev	Remark
1	I am aware of electric vehicle technology	3.40	0.60	Agree
2	I understand how electric vehicles operate	2.60	0.68	Agree
3	I have received training on EV maintenance	2.15	0.73	Disagree
4	EV technology is common knowledge among technicians	2.30	0.70	Disagree

Grand Mean = 2.61

Table 3 shows that respondents perceived automobile technicians to have moderate awareness and knowledge of electric vehicle technology (Grand Mean = 2.61, which is above the cut-off mean of 2.50). However, the findings further indicate limited training and practical knowledge of electric vehicle maintenance among technicians in Kano State.

DISCUSSION OF FINDINGS

The finding on research question 1 revealed that respondents perceived automobile technicians to possess adequate competence in conventional vehicle maintenance but inadequate knowledge and training in electric vehicle (EV) systems. This finding is consistent with Muhammad, Shehu, and Adamu (2025), who found that automotive service technicians in Abuja required substantial training in high-voltage systems, battery management, EV diagnostics, and safety procedures before they could effectively maintain electric vehicles. The finding also agrees with Muoghalu and Ahmad (2024), who reported that modern vehicle maintenance requires competencies in auto-electrical and electronic systems, many of which are insufficiently possessed by technicians and trainees in Nigerian technical institutions.

The finding on research question 2 showed that respondents perceived electric vehicle diagnostic tools and equipment to be generally unavailable in automobile workshops, indicating inadequate infrastructural readiness for EV maintenance in Kano State. This finding is supported by Shanono and Obasi (2025), who found significant disparities in the availability of modern workshop equipment and diagnostic facilities among automobile repair workshops in Nigeria, with many workshops lacking the equipment required for servicing modern vehicles. Similarly, Muhammad et al. (2025) reported that inadequate availability of specialized diagnostic equipment constitutes one of the major constraints to effective EV maintenance in Nigeria.

The finding on research question 3 revealed that respondents perceived automobile technicians to have moderate awareness of electric vehicle technology but limited practical knowledge and formal training

in EV maintenance. This finding is consistent with Lemo (2024), who reported that although Nigerian automobile technicians are increasingly aware of the digital transformation in the automotive industry, many lack the technical competencies required for servicing digital and electric vehicles, thereby necessitating continuous training and retraining. The finding is further supported by Lin et al. (2025), who developed a competency framework for battery electric vehicle maintenance technicians and concluded that effective EV maintenance requires specialized professional knowledge, practical skills, and continuous workforce development beyond conventional automobile repair competencies.

CONCLUSION

Based on the findings, the study concludes that automobile workshops in Kano State are inadequately prepared for electric vehicle (EV) maintenance due to limited technical competencies, inadequate availability of specialized tools and diagnostic equipment, and insufficient practical training despite a moderate level of awareness of EV technology. Consequently, there is a need to strengthen technical training and improve access to modern EV maintenance facilities to support the transition to electric mobility.

RECOMMENDATIONS

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

1. Government agencies, technical institutions, and automobile association's should organize regular training, workshops, and certification programs for automobile technicians on electric vehicle (EV) maintenance, with emphasis on high-voltage systems, battery technology, and electronic diagnostics.

2. Technical colleges, polytechnics, and universities should update their automotive engineering curricula to include electric vehicle technology, hybrid systems, and modern diagnostic techniques to prepare future technicians.

3. Government and private stakeholders should support automobile workshops through subsidies, grants, or soft loans to enable them acquire specialized EV diagnostic tools and equipment.

4. Collaboration should be encouraged between government, automobile manufacturers, and private investors to establish EV maintenance and training centers in Nigeria, especially in major cities like Kano.

5. Automobile technicians should be encouraged to participate in continuous professional development programs to stay updated with emerging automotive technologies.

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